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The European Index of Digital Entrepreneurship Systems

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Foreword

This report is prepared in the context of the three-year research project on Research on Innovation, Start-up Europe and Standardisation (RISES), jointly launched in 2017 by JRC and DG CONNECT of the European Commission. The JRC provides evidence-based support to policies in the domain of digital innovation and start-ups. In particular:

- Innovation with the focus on maximising the innovation output of EC funded research projects, notably building on the Innovation Radar;
- Start-ups and scale-ups – providing support to Start-up Europe; and
- Standardisation and IPR policy aims under the Digital Single Market priorities.

This research builds on the work and expertise gathered within the EURIPIDIS project. It is part of the long-standing collaboration between the JRC and DG CONNECT in the domain of digital innovation and start-ups.

Executive Summary

Digitalisation continues to shape both the nature and location of entrepreneurial opportunities as well as effective practices to pursue them. This development has prompted the global adoption of new organisational innovations to support entrepreneurial opportunity pursuit, such as new venture accelerators, crowdfunding sites, co-working spaces, and entrepreneurship academies. We have witnessed the emergence of a new type of regional agglomeration of economic activity: **the entrepreneurial ecosystem**[1]. This digital entrepreneurial transformation of the economy creates important challenges for policy. To unlock the productivity potential of digital entrepreneurs and thus advance progress towards a Digital Economy, policy-makers need data that describe the framework conditions for digitally enhanced entrepreneurship in their countries.

The **European Index of Digital Entrepreneurship Systems** (EIDES) responds to this policy challenge. The EIDES monitors three kinds of framework conditions in the 28 EU Member States that define how well each EU country supports the digital entrepreneurial dynamic. First, **general framework conditions** describe the general context of doing business in each country. Second, **systemic framework conditions** directly connect with entrepreneurial stand-up, start-up and scale-up. Third, **digital framework conditions** describe the general level of digitalisation of the economy, as it pertains to entrepreneurial activity through its impact on general and systemic framework conditions.

In the EIDES structure, the general framework conditions apply broadly to entrepreneurship, while **the systemic framework conditions differ across three stages of the entrepreneurial dynamic: stand-up, start-up, and scale-up**. The stand-up stage relates to the self-selection of individuals into entrepreneurship. The start-up stage is the subsequent creation of new start-ups. The scale-up stage concerns the scaling up of the start-ups that have discovered a business model with promising growth potential. Accordingly, the EIDES includes three sub-indices for each systemic framework conditions plus their digital versions calculated with measures of the corresponding digital contexts.

The EIDES is a systemic framework index: it describes the context within which the country's entrepreneurial dynamic is embedded and which regulates the quality of this dynamic – i.e., its ability to allocate human, knowledge, financial, and physical capital to productive uses. This systemic aspect is built into the EIDES methodology: in the index, the various components of the system (i.e., the framework conditions) are thought to work as a system to collectively generate the system outputs. This implies that weak system components may operate as bottlenecks that constrain the system's ability to create systemic outputs. The EIDES operationalises the notion of 'Penalty for Bottleneck', which 'penalises' individual index pillars, if some pillars are considerably weaker than others they act as bottlenecks that hold back the system performance.

The 2019 EIDES release is the second EIDES edition. The 2019 EIDES structure has been adjusted in response to changes in data availability. While the names of the sub-indices and individual index pillars have not changed, their variables and indicator composition is different with respect to the 2018 EIDES edition (see Chapter 4 for details) (Autio *et al* 2018c). For comparability, this report also includes the 2018 EIDES scores recalculated with the new 2019 EIDES structure. According to the recalculated 2018 EIDES, from 2018 to 2019 the average index scores increased from 45,5 to 48,0 signalling a 5,6% overall improvement in the digitally enhanced framework conditions for entrepreneurship in the EU28 countries.

According to 2019 EIDES ranking, **Sweden, Denmark, Netherlands, the United Kingdom, Finland, Germany, and Luxembourg are the EU leaders in terms of their digitally enhanced general and systemic framework conditions for entrepreneurship**. Comparing with the 2018 EIDES, the Leader group accounts for the same

[1] An entrepreneurial ecosystem is a regional community of entrepreneurs, advisors, accelerators, and other stakeholders and specialised resources who support entrepreneurial stand-up, start-up, and scale-up and entrepreneurial opportunity pursuit through digitally enhanced business models.

countries. However, Denmark lost the first place while Sweden gained it. Finland climbed two places, from seventh to fifth. **Sweden** ranks first for both start-up and scale-up sub-indices and second for the stand-up sub-index. **Denmark** ranks first for the stand-up sub-index, while secondand third for the scale-up and start-up sub-indices. **Netherlands** ranks third for both stand-up and scale-up sub-indices but fifth for start-up sub-index. Behind the Leader group, with a notable gap, there is **the Follower group,** composed of seven countries: **Ireland, Belgium, Austria, Estonia, France, Malta, and Spain.** A third cluster, the group of **Cathers-up,** is composed of the **Czech Republic, Lithuania, Slovenia, Portugal, Cyprus, and Poland**. From this latter group, Portugal, Cyprus, and Poland moved up from the Laggards group from 2018 to 2019. Finally, **the Laggards group** within the 2019 EIDES ranking comprises the remaining eight countries: **Italy, Hungary, Latvia, Slovakia, Croatia, Romania**, **Greece and Bulgaria.** It is stricking that Italy, one of the G7 countries, is in this group with former centrally planned economies and Greece.

In most countries, **the general and systemic framework conditions tend to perform at a similar level**. There do not appear to be systematic patterns in terms of the relative performance of each group of framework conditions. This means that countries with a lower overall performance may need to invest relatively greater effort to improving general framework conditions, as these regulate all types of business and can also significantly hamper regional dynamics (e.g., market conditions and formal institutional conditions).

The country pages of this report provide an overview of each country's EIDES data, including **the policy optimisation simulation**. This data and the simulation provide a good starting point for entrepreneurial ecosystem policy design in different countries. The bulk of policy attention should be focused at those pillars that are flagged as the more significant bottlenecks in the policy simulation. In some countries, specific pillars are flagged as particularly important bottlenecks, whereas in others, policy attention should focus on two or more pillars. The general objective should be to achieve a good balance across the index pillars.

Attention should be paid to both digitalised pillar scores and non-digitalised pillar scores. This also implies the need for coordination between digitalisation policy and entrepreneurial ecosystem policy.

The EIDES data should be treated as a starting point that feeds into the ecosystem facilitation heuristic as described above and not as the final prescription.

1 Introduction

Digitalisation – the reorganisation of business and society around digital technologies and infrastructures – keeps creating opportunities for entrepreneurs to discover radical new business models and thus challenge established businesses. A novel form of regional clustering of entrepreneurial activity, the 'entrepreneurial ecosystem', has emerged to support this discovery process (Autio, Nambisan, Thomas, & Wright, 2018a). Since this entrepreneurial challenge forces established companies to adopt new and more efficient business practices, entrepreneurial ecosystems can act as an important mechanism to unlock the productivity potential of the Digital Economy.

At present, the productivity potential opened up by digitalisation seems almost inexhaustible, as the Moore's Law shows few signs of slowing down. Intel's founder Gordon Moore famously suggested that the amount of computing power that can be purchased for a given amount of money will keep doubling every 18 months. This trend provides constantly increasing opportunities to boost the wealth-creation potential of the economy in ways that are socially and environmentally sustainable and allow to spot and appropriately respond to any unintended consequences.

In order to effectively harness the opportunities opened up by digitalisation, EU governments need information on how well their respective countries are able to support the entrepreneurial discovery process prompted by digitalisation. Unfortunately, only few metrics exist specifically designed for this purpose. The EIDES has been designed to address this gap and thus help the EU28 governments to design more effective policies to progress towards the Digital Economy.

The digital entrepreneurial transformation of the economy is a broad systemic phenomenon that cannot be satisfactorily captured by count-based measures of individual-level entrepreneurial action. Digitalisation not only shapes opportunities for entrepreneurial action: it also shapes the context within which that action takes place. It is therefore important to monitor the general and systemic framework conditions that regulate the entrepreneurial discovery process set in motion by digitalisation. This report therefore constructs a systemic index that captures both general and systemic framework conditions for digital stand-ups, start-ups and scale-ups.

The 2019 EIDES index presented in this report is the second of three annual updates of entrepreneurial conditions for stand-up, start-up, and scale-up activity in the EU28 countries under the project: JRC/SVQ/ 2017/B.6/0009/NC: "Review and annual updates of the Entrepreneurship and Scale-up Indices". This project builds upon an earlier version of 'Entrepreneurship and Scale-up Indices' (ESIS), created by the Joint Research Centre of the European Commission (Van Roy & Nepelski, 2016). In this report we revise and update the 2018 version of the EIDES and provide an updated account of the digital entrepreneurial framework conditions of the EU28 countries.

We begin by elaborating on the nature and consequences of the process of digitalisation and on how this trend shapes entrepreneurship. Subsequently, we provide an overview of the EIDES structure, including the updates to the 2018 version. We then construct the EIDES and rank the performance of the EU countries with the revised index, and we provide an update of the 2018 EIDES rankings according to the 2019 EIDES structure. We conclude by discussing insights and implications for EU digitalisation, innovation, and entrepreneurship policy.

2 Measuring Entrepreneurship: Challenges and Solutions

As more extensively elaborated in the 2018 EIDES report (Autio, Szerb, Komlósi, & Tiszberger, 2018c), there are many approaches to measuring country-level entrepreneurship. The 2018 EIDES report discussed five categories of these: (1) output (count) measures; (2) attitude measures; (3) framework measures; (4) mixed (weighted) measures; and (5) entrepreneurial ecosystem measures (Acs, Szerb, & Autio, 2014a; Bogdanowicz, 2015; Stam, 2018; Van Roy & Nepelski, 2016). We briefly summarise these below.

Output measures count the incidence of entrepreneurial entries in a given region or country. These can be, for example, counts of new business registrations (World_Bank, 2011), survey-based self-reports of self-employment (Reynolds, Bosma, & Autio, 2005), or counts of specific types of start-ups, such as unicorns (Insights, 2017). Whereas statistics of new business registrations tend to cover all new business registrations while not necessarily covering genuine start-up activity, survey-based measures tend to create estimates of more genuine entrepreneurial and self-employment activity based on limited samples from the underlying population. Both, however, are count measures that track the outputs of the systemic entrepreneurial dynamic (i.e., new entrepreneurial businesses), yet seldom provide insight into the processes that generate those outputs.

Attitude measures proxy social norms and attitudes that are thought to regulate entrepreneurial action through their influence on perceived trade-offs individuals face when considering entrepreneurial action (Autio, Pathak, & Wennberg, 2013). Examples include the Eurobarometer survey, which tracks entrepreneurial career preferences, as self-reported by individuals (Gallup, 2009) and the International Social Survey (ISSP, 1997). Such measures particularly provide a useful proxy of the early stage of the entrepreneurial dynamic– i.e., the stand-up stage, as this is when individuals decide whether or not to engage in entrepreneurial activities – and also, a wider reflection of an 'entrepreneurial culture'. However, these are not measures of actual entrepreneurial activity, and, for example, wider institutional conditions in the country may exercise an important influence on whether and how attitudes give rise to different forms of entrepreneurial action (Autio & Fu, 2015).

Framework measures profile the context for entrepreneurial activity and tend to capture formal institutions and tangible structural conditions (e.g., education level of the population; quality of regulations and entrepreneurship policy interventions; and the availability of resources for entrepreneurship). Example include World Bank's 'Ease of Doing Business' index compared national regulatory frameworks for new business entry (Djankov, La Porta, Lopez-de-Silanes, & Shleifer, 2002), OECD's Entrepreneurship Indicators Programme (Ahmad & Hoffmann, 2008), and the Nordic Entrepreneurship Monitor (Nordic_Council, 2010). While framework measures provide useful information on tangible contextual factors that policy can address, there is usually little information on actual entrepreneurial activity. Most framework measures also treat each framework component individually, without considering how the different conditions work together as a system. This is similar to simply weighing the building materials of a house without considering how these are assembled together.

Weighted measures combine contextual conditions and entrepreneurial outcomes, thus mixing output and framework measures. Examples in point include the Global Entrepreneurship Index (GEI) and the Regional Entrepreneurship and Development Index (REDI) (Acs, Szerb, Autio, & Ainsley, 2017; Acs, Autio, & Szerb, 2014b; Szerb, Acs, Autio, Ortega-Argiles, & Komlosi, 2013). These indices are measures of individual-level entrepreneurial attitudes, abilities, and activity as weights to adjust the magnitude of contextual factors, in an attempt to reflect the *quality* of the entrepreneurial resource allocation dynamic in the economy (Acs et al., 2014b). In the GEI index theory, entrepreneurs are seen as operating a trial-and-error resource allocation dynamic by mobilising resources to pursue perceived opportunities, whereas contextual conditions moderate the potential impact of such resource allocations. Combining the two, weighted measures seek to

move beyond simply tracking entrepreneurial activity and instead focus on the potential economic consequences of such activity. On the downside, interpreting the index tends to grow more challenging with the complexity of the index methodology.

Ecosystem measures are a sub-category of weighted measures and represent the latest evolution in the measurement of entrepreneurship (Stam, 2018; Stangler & Bell-Masterson, 2015). Examples include the Kauffman Foundation's entrepreneurial ecosystem initiative (Stangler & Bell-Masterson, 2015) and the GEI Index. The Kauffman Foundation approach focuses on the structural properties and related dynamics of the entrepreneurial ecosystem in terms of ecosystem density, fluidity, connectivity, and diversity. The GEI index developed a weighted approach, as described above, and as a third alternative approach, Stam (2014, 2018) distinguished between 'framework conditions' and 'systemic conditions', as well as 'outputs' and 'outcomes'. The EIDES has drawn some inspiration from each, as we will elaborate later in the method section.

The different measurement approaches are summarised in Table 1 (Autio et al., 2018c). We next provide a brief overview of how digitalisation impacts both entrepreneurship and innovation.

Table 1. Entrepreneurship measurement approaches: Summary

Approach	Strengths	Weaknesses	Notes
Output measures	Focus on entrepreneurial activity Usually 'clean' measures	Difficulty identifying true entrepreneurial start-ups (registries); identification of consequential start-ups (surveys); tracking informal activity (registries)	Output measures can be combined with other measures to derive actionable policy insight
Attitude measures	Wide coverage (population at large); informs particularly the stand-up stage	Self-reported attitudes may not reflect 'real' attitudes; attitude measures often indirect; self-report measures do not necessarily capture prevailing social norms; assumes straightforward, causal effect of attitudes on action	In spite of problems, attitude measures can illuminate stand-up dynamic
Framework measures	Provide a nuanced reflection of the context of entrepreneurial action; covers conditions that are directly addressable through policy action; usually wide coverage and relevant indicators at the national level; can cover both policy interventions and structural conditions	Do not directly measure entrepreneurial action; the coverage of startups-specific structural elements tends to be patchy (e.g., accelerators) ; underlying logic of selecting framework conditions often unclear; typically assumes direct causal effect on entrepreneurial action although evidence base supporting such an assumption is limited	In spite of its deficiencies, framework indices provide one of the most policy-relevant approaches to assessing contexts for entrepreneurship
Weighted measures	Capture the quality of the entrepreneurial dynamic; able to consider the context both	Makes simplifying assumptions regarding the configuration of systems of entre-	While comprehensive and able to cover all three stages of the entrepreneurial dy-

	as a driver and as a moderator of the entrepreneurial potential; explicitly focuses on economic outcomes realised through entrepreneurial actions; able to guide policy action; the only measures to capture the systemic character of entrepreneurial ecosystems and the co-production of outputs	preneurship; high data demands; assumptions regarding links to economic performance rely on limited evidence; no coverage of the characteristic structural elements of entrepreneurial ecosystems (e.g., accelerators)	namic, the data demands of this approach may render it impractical
Ecosystem measures	Explicitly focused on entrepreneurial ecosystems; focus on contexts of entrepreneurial action; seeks to directly address a digital economy phenomenon; responds to current trends in entrepreneurship	Apart from the Global Entrepreneurship index, current approaches a-theoretical and conceptually inadequate and methodological (measurement content) choices inadequately explained; none of the current operationalisations capture characteristic structural elements of entrepreneurial ecosystems	

Source: 2018 EIDES Report

3 The Digital Context of Entrepreneurial Activity

Digitalisation is the process by which digital technologies and infrastructures get woven into the fabric of the economy and society (Autio & Rannikko, 2017; Yoo, Henfridsson, & Lyytinen, 2010). Two characteristics of digital technologies help explain their transformative impact on innovation and entrepreneurship. First, digital technologies and infrastructures are general-purpose technologies: they can be applied in virtually any sector and to a wide range of functions and activities, potentially transforming these (Carlsson, 2004). Second, being communication and coordination technologies, digital technologies and infrastructures open up new ways to organise business operations. Combined, these two properties make digital technologies and infrastructures a potent enabler of business model innovation – i.e., the re-think of how businesses organise for the creation, delivery, and capture of value (Autio, Nambisan, Thomas, & Wright, 2018b).

Digitalisation enables structural change in the economy by enabling either entirely new functions or by enabling the performance of existing functions in a substantially more effective, efficient, or different way than before (Autio et al., 2018b; Majchrzak & Markus, 2013). Actual structural changes can take many forms in specific settings, but two macro-level outcomes are inevitably driven by digitalisation: (1) horizontalisation of the economy; and (2) servitisation. Horizontalisation refers to the general break-up of long, vertical supply chains and partial reorganisation and connectivity of these around digital platforms. Vertical supply chains are being broken up and flattened through the introduction of business models that harness the Internet for direct delivery of services to and interaction with the end user, thereby bypassing supply chain intermediaries such as downstream distributors. As a case in point, the disruptive business model of low-cost airlines used the Internet to bypass conventional travel agencies, thus helping minimise their costs and cutting steps from the downstream value chain. New fintech companies challenge traditional banks by offering bank account services directly through smartphone applications, thereby challenging the business model of traditional banks, which continue to rely on bank branches for the delivery of some of their services. This is also referred to as the 'disintermediation' effect of the Internet (Jallat & Capek, 2001). As the other aspect of the horizontalisation process, previously linear supply chains are also being reorganised digital platforms, for example, with the introduction of business models that harness digital technologies in novel ways to connect supply and demand. As a case in point, Airbnb is disrupting the hotel industry by connecting travellers and apartment owners. As an example of the second macro trend, servitisation, mobility-as-a-service (MaaS) business models alleviate the need of commuters to own cars and bicycles by offering access to these as a micro-lease service.

The examples above also illustrate some of the ways entrepreneurial ventures leverage digitalisation to undercut traditional industry leaders with innovative business models. As a more general point, the examples also illustrate how entrepreneurs tend to be at the forefront of the business model discovery process triggered by digitalisation. As noted earlier, digitalisation keeps creating, at a geometric rate, opportunities to radically rethink business models. However, the exact nature of these may not be immediately obvious (although sometimes it is), and many reorganisation opportunities need to be discovered and validated through trial-and-error experimentation. It is this discovery process where the role of entrepreneurs is crucial, because new firms are not constrained by legacy investment in old business models that may be rendered obsolete by digital advances. In the Airbnb example above, traditional hotel chains were always an unlikely candidate to discover and launch the apartment mediation model, simply because they had optimised their operations around a physical asset: the hotel buildings around which they had built their operation. Similarly, Netflix was able to end the dominance of the Blockbuster Video in video rental business, not because Blockbuster Video had been blind to the threat that Netflix's original DVD rental business model posed, but simply because its hands were tied by its considerable investment in video rental stores. These could not

be dismantled overnight, enabling Netflix an opportunity to scale its business model and eventually transition its dominance from DVD rental to direct streaming.

It is this digitally enabled business model discovery dynamic that makes entrepreneurial ventures a central driver of progress towards the Digital Economy and towards unlocking the productivity potential opened up by digitalisation. It is therefore centrally important for policy-makers to pay attention to this dynamic and to design effective policies for its support.

A novel cluster type, the entrepreneurial ecosystem, has emerged during the past decade or so to support the digitally enhanced business model discovery dynamic (Autio et al., 2018a; Feld, 2012; Spigel, 2017). Entrepreneurial ecosystems are regional communities of entrepreneurs, business angels, accelerators, and other stakeholders who specialise in facilitating business model experimentation and related knowledge spill-over among new stand-up, start-up, and scale-up ventures. Entrepreneurial ecosystems also facilitate new ventures' access to specialised resources to support entrepreneurial start-up and scale-up. Characteristic structural elements of entrepreneurial ecosystems include, for example, new venture accelerators, co-working spaces, specialist financiers, consultants, lean entrepreneurship coaches, entrepreneurial networks and event organisers. The importance of digitalisation for the entrepreneurial ecosystem phenomenon is highlighted in the fact that the first modern new venture accelerator, the Y-Combinator, was launched in Silicon Valley in 2005, only a year after the term: 'Web 2.0' was coined – in a web developer conference also held in Silicon Valley.

The above review suggests one distinctive aspect about entrepreneurial ecosystems as a novel cluster type that characterises the digital economy[2]. As reviewed above, in traditional clusters of the vertical manufacturing economy, the locus of entrepreneurial opportunities was localised, driven by value chain specialisation, and tended to drive process innovation: greater output efficiency at the level of the value chain through enhanced user-producer role specialisation and coordination (Autio & Levie, 2017a). Most knowledge spill-overs operated vertically, in user-producer relationships. Horizontally organised digital platforms dominating as sources of opportunity in entrepreneurial ecosystems, the key source of knowledge spill-overs migrates towards horizontal relationships among non-competing firms. As new ventures in venture accelerators typically do not compete directly with one another, yet compete with the same means (i.e., radical business model innovation), they have an incentive to share experiences, as such experience sharing helps all new ventures become more effective in competing against industry incumbents. This also means that entrepreneurial ecosystems facilitate not so much linear, technology-push innovation, but rather, business model innovation, which harnesses digital affordances for the transformation of value processes in the economy (Autio & Levie, 2017a).

These trends create new challenges for policy. In the digital age, the key policy challenge becomes facilitating regional entrepreneurial ecosystems and country-level systems of entrepreneurship instead of focusing on individual SMEs, as is the case in traditional SME policy (Autio, 2016; Autio & Rannikko, 2016). An ecosystems approach to entrepreneurship policy emphasises the facilitation of entrepreneurial experimentation and business model discovery – for example, by facilitating interactions among stand-ups and start-ups to share effective business model practices. Supporting such sharing is typically a key objective of, say, co-working spaces, new venture accelerators, and corporate accelerators. Instead of a siloed, top-down approach aimed at fixing static, easily observable 'market' and 'system' failures, entrepreneurship policies need to address the entire entrepreneurial discovery and resource allocation dynamic that is facilitated by entrepreneurial ecosystems (Autio & Levie, 2017b; Autio & Rannikko, 2017). At the national level, we label this as a 'systems of entrepreneurship' approach (Acs et al., 2014b). The EIDES has been designed to cater to these policy challenges. We next introduce the EIDES methodology.

[2] The entrepreneurial ecosystem phenomenon is in no way limited to advanced economies only. The first new venture accelerator in Bangalore was opened in 2008, and by 2016, their number had grown to 13.

4 EIDES Methodology

4.1 Conceptual Grounding

The underlying EIDES concept draws on the entrepreneurial ecosystem (EE) literature. Although this is a fresh approach, it also introduces some conceptual ambiguity, given the (until recently) relatively weak theoretical grounding of this literature. The strength of the entrepreneurial ecosystems approach is the ability to incorporate many layers of the entrepreneur's context, highlighting the close relationships, interdependencies, and reinforcing mechanisms across the different constituent elements of the entrepreneurial ecosystem, often centred around a focal community of ecosystem constituents (Autio et al., 2018a; Spigel, 2017). A weakness of the approach is that most conceptualisations are descriptive, rather than theory-grounded, and tend to emphasize different layers, structural elements, and processes of entrepreneurial ecosystems (Mason & Brown, 2014; Stam, 2018).

One theoretical ambiguity of the entrepreneurial ecosystems literature concerns the level of analysis. While there are some country-level conceptualisations, most conceptualisations tend to treat entrepreneurial ecosystems as a regional phenomenon. A recent comprehensive theoretical review confirmed that entrepreneurial ecosystems should be viewed as a novel, distinct type of regional cluster, one that harnesses both digital and spatial affordances (Autio et al., 2018a). The review argued that the essence of the entrepreneurial ecosystem phenomenon is the exploitation of digital affordances created by rapid advances in digital technologies and ubiquitous digital infrastructures for radical business model innovation – i.e., for a re-think on how businesses organise to create, deliver, and capture value. Many modern-day structural elements of entrepreneurial ecosystems, such as new venture accelerators and co-working spaces have emerged to facilitate business model experimentation and the discovery of robust and scalable business models. Such structural elements become focal points around which regional clusters of specialised actors and resources tend to cluster, thereby giving birth to regional hubs of entrepreneurial activity. Given the spatial clustering pattern associated with such developments, we suggest that, for conceptual clarity, it is best to restrict the use of the term: 'entrepreneurial ecosystems' to regional phenomena.

Although the entrepreneurial ecosystems literature is best suited for understanding regional phenomena, we are not implying that a country-level analysis would not be relevant. For example, many framework conditions only operate at the national level and are shared across regions (e.g., legal and regulatory frameworks). And, although many resources tend to exhibit regional clustering, so does entrepreneurial activity. Therefore, national aggregates provide a reasonable proxy of what is going on in that country's regional concentrations of entrepreneurial activity. Finally, although entrepreneurial ecosystems may be spatially concentrated, the contributions of their dynamic still add to countries' GDP. In order to distinguish a country-level unit of analysis, we therefore adopt the concept of 'systems of entrepreneurship' to communicate the country-level focus of the EIDES (Acs et al., 2014b).

4.2 Index Structure

The EIDES structure is presented in Figure 1. As core pillars of the index, the EIDES distinguishes between General Framework Conditions and Systemic Framework Conditions. General Framework Conditions represent country-level conditions that regulate entrepreneurial activity in the country through their effect on social and economic trade-offs, as experienced by individuals and entrepreneurial teams. Systemic Framework Conditions represent various types of resources available to entrepreneurial firms at three stages of their lifecycle: (1) the stand-up stage, which captures idea formation and the self-selection of individuals to entrepreneurship; (2) the start-up stage, which captures the actual launch and start-up of the new venture including early business model experiments; and (3) the scale-up stage, which captures the scale-up of those new ventures

that have discovered a robust and scalable business model. In addition to general and systemic framework conditions, the EIDES also captures the level of digitalisation of the country's economy, labelled as Digitalisation Conditions.

The EIDES distinguishes between four General Framework Conditions: Culture and Informal Institutions, Formal Institutions and Regulatory Framework, Market Conditions, and Physical Infrastructure. Of these, Culture and Informal Institutions regulate individual-level attitudes towards entrepreneurship as a career choice. Formal institutions and regulatory framework shape the context within which firms do business and affect entrepreneurial choices (including entry into entrepreneurship as well as post-entry growth aspirations) through their effect on the cost of doing business and the uncertainty regarding, e.g., property ownership and enforceability of contracts. Market conditions regulate the size and accessibility of market opportunities. Physical infrastructure regulates the cost and ease of doing business.

The EIDES also distinguishes between four Systemic Framework Conditions: Human Capital and Talent, Knowledge Creation and Dissemination, Finance, and Networking and Support. Human Capital and Talent capture the quality of human capital available for entrepreneurial ventures. Knowledge Creation and Dissemination captures the availability of knowledge inputs into new ventures in the form of, e.g., technology and professional skills. Finance captures the availability of various forms of finance for new ventures. Networking and Support captures various forms of support services, both public and private, available for new ventures.

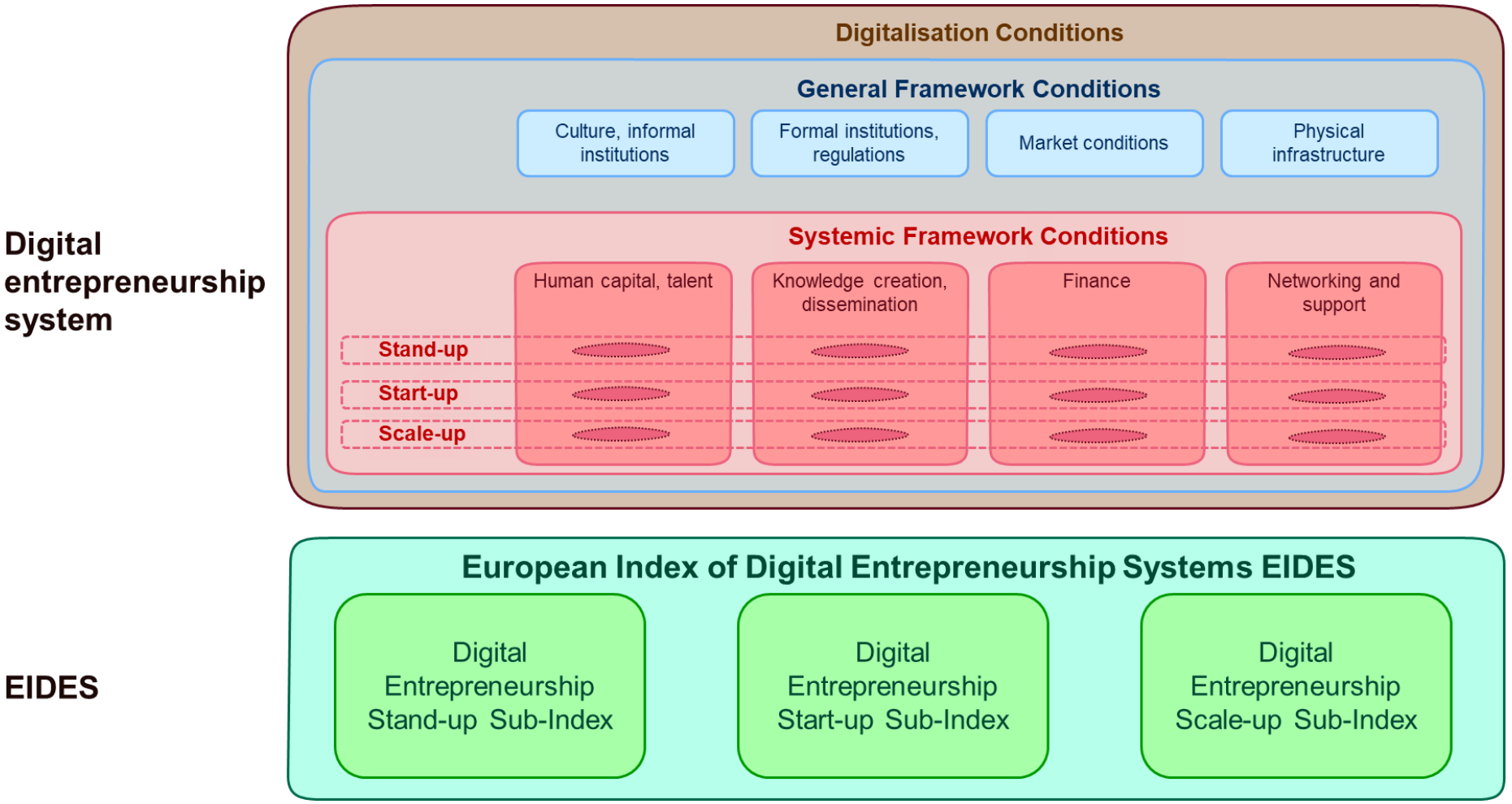
Whereas General Framework Conditions apply generally to different stages of the entrepreneurial process, the EIDES distinguishes between three stages of the entrepreneurial firm lifecycle when it comes to Systemic Framework Conditions: 'stand-up', 'start-up', and 'scale-up' stages. Accordingly, Systemic Framework Conditions are divided into three sub-indices, each representing one of the three stages.

Whereas the General Framework Conditions regulate what choices entrepreneurial individuals and teams are likely to make in the context of the entrepreneurial venture, the Systemic Framework Conditions capture the resources entrepreneurs can access when converting those choices into entrepreneurial action. Also, whereas the General Framework Conditions operate mostly at the national level, the Systemic Framework Conditions tend to exhibit more variance across regions. However, in the EIDES, both types of framework conditions are measured at the national level due to scarcity of regional-level data.

Digitalisation is included in the EIDES as Digitalisation Conditions that apply throughout the country. This reflects the notion that digitalisation is a process by which digital technologies permeate the economy and society, making them infrastructural (Tilson, Lyytinen, & Sørensen, 2010). Each of the sixteen pillars[3] of the EIDES (four operationalising General Framework Conditions and twelve operationalising the four Systemic Framework Conditions along the three stages of the entrepreneurial life-cycle – i.e., Stand-up, Start-up, and Scale-up) is 'digitalised' by using an appropriate Digital Condition as a pillar weight.

[3] The EIDES index structure distinguishes between different types of framework conditions. When operationalised during the index calculation, these are converted into index pillars. We thus have four pillars for General Framework Conditions and a total of twelve pillars for Systemic Framework Conditions due to the differentiation of the four Systemic Framework Conditions across three new venture lifecycle stages.

Figure 1. Structure of the EIDES Index



4.3 Index Operationalisation

The variable composition of this, the second edition of the EIDES has been slightly revised and updated from the first, 2018 edition. The structure of the EIDES is provided in Table 2. The operationalisation of the EIDES includes the following steps:

- Determination of the overall structure of the EIDES (explained in Chapters 4.1 and 4.2 above)
- Determination of the variable composition of EIDES pillars
- Calculation of individual pillar values
- Digital weighting of individual pillar values for a digitalised form of the pillar
- Calculation of sub-index values
    - General Framework Conditions (digitalised or non-digitalised)
    - Systemic Framework Conditions (digitalised or non-digitalised), including
        - Stand-up (digitalised or non-digitalised)
        - Start-up (digitalised or non-digitalised)
        - Scale-up (digitalised or non-digitalised)
- Calculation of the overall EIDES value

Annex 2 provides a detailed explanation of the methodological steps.

In the EIDES, both General Framework Conditions and Systemic Framework Conditions are operationalised as index pillars that are composed of sets of individual variables. The variables included in each index pillar are listed in Table 2.

Individual pillar values are calculated as arithmetic averages of the values of individual pillar variables after normalisation. Each framework condition is thus represented by a single pillar value. Because the EIDES calculates different pillar values for Systemic Framework Conditions for each of the three lifecycle stages of entrepreneurial firms, the index is composed of a total of 16 pillars.

The EIDES also calculates a measure of the digital context for each index pillar. These measures are listed in the rightmost column of Table 2. Each index pillar is matched with a Digital Framework Condition that resonates with it. The measures of the different Digital Conditions (one for each pillar) are calculated as the arithmetic average of their constituent variables after normalisation.

The resulting measures of specific Digital Framework conditions are then used as weights to calculate the digitalised version of each of the index pillars. The index thus offers two pillar values for each General and Systemic Framework Conditions: a digitalised value and a non-digitalised value.

In order to capture system dynamics, two important methodological steps are followed when aggregating individual pillar values into sub-indices: the equalisation of pillar averages and the Penalty for Bottleneck algorithm (Acs, Autio and Szerb 2014). Most of the indices make the strong and often unrealistic assumption that individual pillar values are fully substitutable among one another. In the context of the EIDES, this would mean making the strong assumption that, say, the negative impact of weak Market Conditions could be fully mitigated by, say, strong Culture and Informal Institutions; or, making the assumption that the negative impact of gaps in Human Capital and Talent could be fully remedied by increases in Finance. Methodologically, the full substitutability assumption is reflected in the way most indices calculate sub-index values as the simple arithmetic mean of the pillar values that compose that sub-index. However, the assumption of full substitutability among index pillars is simplistic, and it does not reflect the reality of most economic systems. We know, for example, that if a given venture has zero access to Finance, it cannot fully leverage its Human Capital and Talent, however good these might be. Similarly, a strong entrepreneurial culture cannot easily overcome weak market demand. In complex systems, the different constituent elements tend to complement, rather than substitute one another, and they need to come together to co-produce system-

level outcomes. If one spoke of a bicycle wheel is broken, this cannot be made up for by making another spoke longer.

In order to address the assumption of full substitutability among system components that affects most indices, the EIDES equalises pillar averages and applies the Penalty for Bottleneck algorithm when aggregating individual pillar values into sub-indices. The full details of these steps are explained in Annex 2. The equalisation of pillar averages involves adjusting the scales of each pillar within the sample such that the average of the values for each pillar is the same. The Penalty of Bottleneck algorithm introduces partial non-substitutability across individual pillars (say, increases in Finance can only partly substitute for gaps in Human Capital and Talent). When individual pillars can only partly substitute each other, each of the General or Systemic Framework Conditions may act as a bottleneck that holds back the performance of the entire system. To capture this issue, the Penalty for Bottleneck algorithm 'penalises' for gaps in the pillar composition of a given sub-index by inflicting a greater bottleneck penalisations for greater variances among pillar values (i.e., greater differences among individual pillar values) in any given sub-index,. This captures the notion that a poorly performing framework condition can hold back the performance of the entire system.

After these steps, the values of each sub-index (one for General Framework Conditions, three for Systemic Framework Conditions, all framework conditions in digital and non-digital versions) are calculated as arithmetic means of equalised, bottleneck-penalised pillar values. The overall sub-index value for Systemic Framework Conditions is calculated as the arithmetic mean of the sub-index value for stand-up, start-up, and scale-up sub-indices.

Finally, the value of the overall EIDES is the arithmetic mean of the measures for General and Systemic Framework Conditions.

This approach, we believe, provides a good and true-to-phenomenon portrayal of national entrepreneurship systems, where general framework conditions regulate the degree to which the systemic conditions can realise their full potential, and where the systemic conditions are directly involved in the co-production of the national-level entrepreneurial dynamic. The EIDES approach also distinguishes between digital and non-digital versions of the dynamic, making it possible to estimate the effect of digitalisation on the system's ability to support a high-quality entrepreneurial dynamic. The distinction between systemic conditions and the three sub-dynamics of the overall entrepreneurial dynamic also makes it possible to support more nuanced policy insights: first, for general framework conditions for entrepreneurship; second, for digitalisation; and third, for the three sub-dynamics of the overall entrepreneurial dynamic.

In this report we focus on the creation and the analysis of the EIDES and only marginally deal with the connection between EIDES and the outputs of the country's entrepreneurial dynamic. The variable composition of each of the EIDES pillars is shown in Table 2.

Table 2. Structure of the European Index of Digital Entrepreneurship Systems

Pillars	**General Framework Conditions (GFC)**			**Digital Framework Conditions, DFC**
Culture and Informal Institutions (P1)	Social desirability and acceptance of entrepreneurship, efficiency of legal framework, corruption	Population attitude toward start-up risk	Corporate governance, reliance on professional management, willingness to delegate authority	Basic use of the Internet by population and businesses
Formal Institutions, Regulation and Taxation (P2)	Rule of law, private property protection	Ease of start-up (regulation)	Government effectiveness in terms of services and taxation,	Freedom of the net (competition) vs security, e-government
Market Conditions (P3)	Local, domestic market conditions, urbanisation	Ease of entry to local market (market dominance, exploiting business opportunities)	Internationalisation	Use of the net for sales
Physical Infrastructure (P4)	Electricity infrastructure (access & quality)	Transport infrastructure (quality & efficiency of service)		Digital infrastructure, access, cost, speed and reliability
Pillars	**Systemic Framework Conditions (SFC)**			**Digital Framework Conditions, DFC**
	Stand-up stage (S1)	**Start-up stage (S2)**	**Scale-up stage (S3)**	
Human Capital (P1)	Quality of education system, education level of population, entrepreneurial education	Advanced education, quality of university education, STEM education, entrepreneurial skills, entrepreneurship education	Life-long learning, labour market conditions, mentoring, serial entrepreneurs	Internet access in schools, digital skills, e- learning, availability of IT personnel, general internet use
Knowledge Creation and Dissemination (P2)	Skillset of graduates, efficient use of talent, professionals & researchers	Quality of research institutions, technology and knowledge transfer (science in schools)	Research and innovation capacity (R&D), knowledge absorption, university-industry collaboration	Internet for knowledge dissemination (Wikipedia, YouTube), ICT personnel, ability of businesses to use the Internet
Finance (P3)	Availability of credit, SME finance	Early stage entrepreneurial finance, VC availability, business angels	Later stage finance, private equity financing	Digital finance
Networking and Support (P4)	Attitudes toward entrepreneurs	External support for start-ups, networking	Clusters and value chain development	Use of social media and virtual networks

4.4 Variable Content of EIDES 2019

The variable content of EIDES 2019 has been amended to capture the availability of new data and the obsolescence of some old data. A major source of changes was the publication of a new version of the Global Competitiveness Index (WEF, 2018), which dropped some variables used in the previous edition of EIDES. These have been replaced with appropriate proxies from the new GCI data. There were also other instances where previously used indicators were either no longer available or had not been updated since the previous EIDES edition. All changes in the dataset are summarised in Annex 1.

In updating the EIDES variable content, we tested alternative proxies for each pillar and selected variables on the basis of their coverage of the relevant aspect as well as their pertinence to the phenomenon we sought to portray. Specific selection criteria for individual variables were:

1. Relevance of the variable for the construct we sought to measure
2. Clear interpretation of the variable
3. Explanatory power
4. Distinctiveness relative to other variables in the pillar
5. Comprehensiveness of the combined set of variables in the pillar relative to the construct we sought to measure
6. Positive correlation between each pillar, when fully composed, and the overall EIDES
7. Specificity of the variable to the phenomenon it represents

So as to ensure index continuity, we have re-computed the 2018 edition of the EIDES using the variables of the EIDES 2019 edition. This is provided in Table 5.

4.4.1 General Framework Conditions

By influencing financial and social trade-offs related to entrepreneurial choices, General Framework Conditions (GFC) regulate the quality of a country's entrepreneurial dynamic. Most GFCs change slowly. The EIDES assumes that each general framework condition exercises a more or less equal influence on the country's entrepreneurial dynamic.

Culture and Informal Institutions (GFC_P1 and DFC_P1)

Corruption has a negative effect on economic activity because it undermines the rule of law and erodes the predictability of economic relationships. When the level of corruption is low and the quality of governance is high, citizens are more likely to accept entrepreneurial risk. To incorporate the effect of corruption we used two survey-based composite indices. The *World Economic Forum (WEF) Efficiency of legal framework in setting disputes* indicator reflects the efficiency of the national level legal and judicial systems for companies in settling disputes. The *Transparency International Corruption Perceptions Index* aggregates data from a number of different sources and gives an estimate of the perceived level of corruption in the public sector. In addition, the *WEF Corporate governance* reflects different dimensions of good corporate governance, such as auditing and reporting standards, interest regulations, and shareholder governance, and also, the country's norms of business ethics.

In addition to corruption, fear of failure can have a negative impact at all stages of the entrepreneurial dynamic. The way how a nation's citizens perceive and handle failure is influenced by their sociocultural norms. We use the *WEF Attitudes towards entrepreneurial risk* indicator as a proxy of this construct.

Another important aspect of entrepreneurial culture is the reliance upon professional management. If professional management is not valued, this may hold back the country's entrepreneurial dynamic. We therefore included the *WEF Reliance on professional management* survey indicator into our composite pillar.

Another reflection of managerial professionalism is the willingness to delegate. If entrepreneurs are unwilling or unable to delegate, this will hold back their ability to grow their businesses. The *WEF Willingness to delegate authority* indicator captures the willingness to devolve decision-making and involve other managers and subordinates in business planning and operations.

Digitalisation is rapidly shaping and changing social norms, cultural values and practices, and other informal institutions. This impact of digitalisation will depend on the availability and accessibility of digital technologies and infrastructures. The digital pillar complementing the general *Culture and Informal Institutions (DFC_P1)* pillar therefore includes proxies capturing how easily citizens and businesses can harness the digital infrastructure of their country. We use four indicators to proxy the accessibility and use of digital technologies and infrastructures by households and firms in a given country. All data are derived from Eurostat database: (1) *Percentage of households having access to, via one of its members, a computer,* (2) *Percentage of households with Internet access at home,* (3) *Percentage of individuals using the Internet (in the last 3 months),* and (4) *Percentage of enterprises having a website (Eurostat).*

Formal Institutions and Regulatory Framework (GFC_P2 and DFC_P2)

The connection between a country's formal institutions (including the regulatory framework) and entrepreneurship has been widely investigated, and it has been shown to impact both the quality and quantity of entrepreneurship in a given country (e.g., Autio & Fu, 2015). The indicators included in the EIDES inform on obstacles of the regulatory environment and on the need to improve the quality and efficiency of formal institutions and regulations: (1) *Rule of Law (Property rights)*, (2) *Rule of Law (Judicial Effectiveness),* (3) *Distortive effect of taxes and subsidies on competition*, (4) *Total tax rate and* (5) *Efficiency of legal framework in challenging regulations*.

The *Heritage Foundation Rule of Law* index captures mechanisms by which societies enforce laws and regulations and protect property. The rule of law is a crucial mechanism that curtails corruption and therefore encourages entrepreneurial risk taking. Under a strong rule of law people feel that their personal liberty and the fruits of their labour will be protected. In contrast, under a weak rule of law, there are no guarantees that any effort by citizens will be respected, nor are there effective limits to government abuse, bribery, special interests, and corrupt rent seeking. This composite index incorporates different aspects of the rule of law, including physical and intellectual property rights, the strength of investor protection, the risk of expropriation, the judicial effectiveness and independence, and the transparency of governmental policymaking and civil services.

In a favourable business environment, entrepreneurial activities are supported by predictable fiscal regulation and a reliable governance system. In the EIDES, the *World Bank Total tax rate* indicator and *WEF Distortive effect of taxes and subsidies on competition* compare national tax systems and capture their effect on business investment. We also included WEF indicator *Efficiency of legal framework in challenging regulations* to capture the quality of government.

As outlined earlier, digitalisation brings about many benefits. As a downside, digitalisation can also introduce new risks that may inhibit entrepreneurial action. A particular potential downside concerns loss of privacy and security. In the EIDES, the digitalisation related *Formal Institutions, Regulation, and Taxation (DFC_P2)* pillar therefore encom-

passes several indicators reflecting this aspect of digitalisation. This pillar also includes proxies that measure how formal institutions and the regulatory environment shape digitalisation processes and competition. The pillar also captures the digitisation of public services, focusing on e-government. Modernisation and digitalisation of public services can lead to efficiency gains for the public administration, citizens and businesses through the delivery of high-quality services. The pillar includes indicators such as: (1) *Government future orientation (WEF)*, (2) *Percentage of network attacks by Kaspersky (Securelist)*, (3) *Percentage of WEB treats (Securelist)*, (4) *Software piracy rate (World Bank)*, (5) *Competition in network services (WEF)* and (6) *E-government (UN Department of Economic and Social Affairs).*

Market conditions (GFC_P3 and DFC_P3)

Market conditions constitute one of the most important regulators of a country's entrepreneurial dynamic. This pillar includes indicators reflecting different features of market conditions, such as the effect of agglomeration externalities, the market power of existing businesses and business groups, domestic and foreign market size, and also, perceptions of entrepreneurial opportunities.

Agglomeration externalities are positively associated with entrepreneurship because they facilitate opportunity recognition and exploitation, and also, make it easier for demand and supply to meet. These processes are enhanced by urbanisation. This pillar therefore includes the *WEF Domestic market size* and the *Level of urbanisation* calculated by *World Population Prospects*. Domestic market size indicator refers to the sum of gross domestic product plus the value of imports of goods and services minus exports of goods and services.

Market conditions can also influence opportunity perception. The *Flash Eurobarometer Survey Opportunity motivation* indicator refers to the entrepreneurial opportunity perception by the population. Specifically, it measures the degree to which a country's citizens prefer self-employment over regular employment.

The intensity of competition among business firms is an important indicator of the entrepreneurial dynamic. The relevant indicators in the EIDES reflect managerial perceptions regarding the freedom of market competition (*WEF Extent of Market dominance*), the freedom (*WEF Prevalence of trade barriers*), and complexity of trade (*Economic complexity index developed by the Observatory of Economic Complexity (OEC)*).

The digital counterpart of the *Market Conditions (DFC_P3)* pillar characterises the exploitation of online market channels (e.g., e-commerce, e-sales, e-advertisement) by households and firms. By adopting digital technology, entrepreneurial businesses can enhance efficiency, reduce costs and better engage customers, collaborators, and business partners. Furthermore, the Internet also offers wider access to markets. The digital pillar includes the following six indicators derived from Eurostat and one from Translate.net database: (1) *Individuals using the Internet for ordering goods or services*, (2) *Enterprises having received orders via computer-mediated networks*, (3) *Enterprises' total turnover from e-commerce*, (4) *Enterprises' turnover from web sales*, (5) *T-index,* and (6) *Pay to advertise on the Internet*.

Physical infrastructure (GFC_P4 and DFC_P4)

A country's physical infrastructure plays an important role in supporting business operations, and therefore, also entrepreneurship. Physical infrastructure regulates, e.g., firms' accessibility and connectivity with markets, resources, and other firms. Good accessibility and connectivity enabled by physical infrastructures help business firms and entrepreneurs effectively discover and pursue market opportunities and run their operations. Countries with an effective physical infrastructure are also better positioned to promote the internationalisation of firms, therefore facilitating the realisation of their growth potential.

The EIDES distinguishes between two types of physical infrastructures: first, the electricity infrastructure, and second, the transportation infrastructure. The *WEF Electricity infrastructure* aggregate index consists of two indicators measuring electricity access and the quality of the electricity infrastructure. Another WEF aggregate indicator, namely, the *Transportation infrastructure,* comprises indicators of the perceived quality of general infrastructures (e.g., transport, communication, and energy).

The digital pillar complementing the Physical Infrastructure pillar *(DFC_P4)* encompasses indicators reflecting quality-related features – such as affordability, speed, security, and coverage – of the digital infrastructure. Limited affordability of network services, devices, and applications impedes consumer engagement with the digital economy and widens the digital divide. In EIDES, therefore, the digital affordability indicator captures the costs of mobile telephony and fixed broadband Internet, as well as the level of competition in the Internet and telephony sectors. Here we use indicators derived from the WEF database, such as the (1) *Prepaid mobile cellular tariffs,* the (2) *Fixed broadband Internet tariffs.*

Speed related indicators measure the performance of digital services such as mobile and fixed broadband. To capture the speed of digital devices and services we use: (1) *Average download speed* and (2) *Average upload speed* measured by *TestMy.net,* and the (3) *DESI Speed* indicator.

Mobile network coverage refers to the penetration rate of portable digital devices. To express the penetration of mobile infrastructure we use the *WEF Mobile network coverage* indicator.

In addition to capacity measures, another important aspect of digital infrastructures relates to trust and safety. Poor protection of data and communications hampers digital trust and potentially undermines the degree to which citizens and businesses embrace the digital capacity available to them. The EIDES therefore employs the *WEF Secured Internet servers* indicator to capture digital trust and safety.

4.4.2 Systemic Framework Conditions

As explained in the conceptual grounding, the *Systemic Framework Conditions (SFC)* relate more directly to the different stages of entrepreneurial sub-dynamics within a country's system of entrepreneurship. Each stage constitutes its own sub-index. We use the same four pillars for each stage, but pick different indicators (or indexes) for each of them.

- The ***Stand-up*** stage covers all activities and mechanisms associated with the self-selection of individuals and teams into the entrepreneurial process: a well-functioning stand-up framework will attract high-potential individuals and teams into entrepreneurship.
- The ***Start-up*** stage covers all activities and mechanisms associated with the actual start-up of new ventures, including concept search and refinement and business model experimentation. In our model, start-up continues beyond the actual incorporation of the new venture and covers the business model experimentation to discover a robust and scalable business model.
- The ***Scale-up*** stage covers scale-up activities once a robust and scalable business model has been discovered.

The EIDES also distinguishes between conditions that are *not* affected by digitalisation (*Systemic Entrepreneurship Conditions, SEC*) and that *are* affected by digitalisation (*Systemic Digital Conditions, SDC*). Both groups use the same pillar structure, but the composition of each individual pillar is different. The pillar structure of both *SEC* and *SDC* is listed below:

1. Human capital *(SEC_P1* and *SDC_P1)*

2. Knowledge creation, transfer, and absorption *(SEC_P2* and *SDC_P2)*
3. Finance (SEC_P3 and SDC_P3)
4. Networking and support *(SEC_P4* and *SDC_P4)*

Systemic Entrepreneurship Conditions and Systemic Digital Conditions

Stand-up sub-index (S1)

The Stand-up sub-index captures mechanisms that influence the self-selection of individuals into entrepreneurship – i.e., the decision of whether or not to start a new business. The EIDES structure includes both digital and non-digital versions of this sub-index.

Human Capital pillar (S1_SEC_P1 and S1_SDC_P1)

Human capital constitutes an important determinant of the quality of entrepreneurial businesses. Individuals with a higher human capital will be better able to recognise and pursue high-quality opportunities for entrepreneurship (Davidsson & Honig, 2003). The opportunity costs associated with the allocation of high-quality human capital among alternative occupational pursuits will also ensure that entrepreneurs with high human capital will be more motivated to pursue potential growth opportunities (Autio & Acs, 2010).

The availability of high-quality human capital is determined by the quality of the education system. We measure two aspects of this human capital, namely, *general human capital* (general quality of the education system) and *entrepreneurial human capita*l, as shaped by the ability of the education system to encourage entrepreneurial attitudes. In order to measure the two types of human capital we used the following indicators: (1) *IMD World Talent Ranking Quality of Education* is an aggregate index based on three measures (educational system, university education, and management education), (2) *Flash Eurobarometer Survey* measures *Entrepreneurial attitudes at school*, and (3) *WEF Future workforce* evaluates the capacities of the future workforce based on different characteristics of the education system.

The digital counterpart of the *Human Capital* pillar captures the availability of digital infrastructure in educational institutions and the basic digital skills of the population. To evaluate the digitalisation of education we use *Eurostat Individuals with a daily access.* To measure people's digital skills we employ two indicators: (1) *WEF Digital Skills Among Population*, and (2) *Eurostat Individuals above basic digital skills*.

Knowledge creation, transfer and absorption pillar (S1_SEC_P2 and S1_SDC_P2)

Entrepreneurial stand-up in a country is shaped by the degree to which potential entrepreneurs can access valuable knowledge to fuel their business ventures. Much of this knowledge is carried by individuals, in the form of their human and social capital. A country's ability to attract and retain talent not only provides entrepreneurial ventures with access to valuable human resources, such talent will also boost knowledge creation in the country, facilitating potential knowledge spill-overs to new ventures. The EIDES uses WEF index data to capture this aspect: *Skillset of graduates (WEF), Percentage of professionals & researchers (Global Talent Competitiveness Index),* and *Attracting and retaining talents (IMD World Talent Ranking)*.

Digitalisation shapes the process of knowledge creation, transfer and dissemination. With digitalisation, access to knowledge becomes less constrained by spatial distance, as the Internet can facilitate access to digitalised knowledge resources regardless of location. The indicator *Open access of scientific documents* offered by OECD and indicators of *Global Innovation Index* such as *Wikipedia yearly edits* and *YouTube video uploads* are

therefore used in the EIDES as proxies of the impact of digital technologies and infrastructures on the creation and dissemination of knowledge.

Finance (S1_SEC_P3 and S1_SDC_P3)

Availability of finance is widely recognised as a key regulator of the entrepreneurial dynamic in countries, including the Stand-up stage. Both the amount of funding matters, as does the accessibility by entrepreneurial ventures to such funding. The *Domestic credit (International Monetary Fund, International Financial Statistics)* indicator measures the generally prevalent forms of funding, such as loans, non-equity securities, and trade credits and other accounts receivable. Additionally, the *Financing SMEs (WEF)* indicator provides insight into the extent small- and medium-sized enterprises can access finance through the financial sector.

As digital proxies we use indicators as *Digital payment transactions* and *Number of cashless payment transactions*. Both indicators are offered by *Statista* and *Internet Banking* measured by *Eurostat*. On the one hand, these indicators capture the effect of digital technologies and infrastructures on the functional operation of financial institutions. On the other hand, these proxies offer insight into the new generation of digitalised financial products and services.

Support, networking (S1_SEC_P4 and S1_SDC_P4)

Positive attitudes towards entrepreneurship encourage entrepreneurial stand-up, as does informal access to resources though social networks. We therefore included the *Opinion about Entrepreneurs* indicator offered by *Flash Eurobarometer Survey* in the EIDES. To capture networking and digitalisation, we included the *Generic top-level domains (gTLDs) (GII)* and *Participating in social networks (Eurostat)*, *and Use of virtual professional networks (Global Talent Competitiveness Index)* in this pillar.

Start-up sub-index (S2)

Human capital (S2_SEC_P1 and S2_SDC_P1)

Societies with high-quality educational systems are better able to supply entrepreneurial start-ups with high-quality human capital. In the start-up sub-index, we therefore included several proxies of different aspects of the education system. These included *Tertiary education enrolment (WEF)* and *Percentage of universities with top rankings in international league tables (Webometrix)*. Furthermore, human resources in science and technology are particularly relevant for new start-ups. This pillar therefore employs indicators such as the *STEM education* and the *Human resources in science and technology* indicator offered by *Eurostat.* As digital proxy of the educational system, we included the *Employed ICT specialists (Eurostat)* indicator to capture the availability of digitally skilled human capital.

Knowledge creation, transfer and absorption (S2_SEC_P2 and S2_SDC_P2)

Start-ups need access to advanced research-based knowledge in order to nurture distinctive capabilities and create sophisticated products and services. In order to convert this knowledge into a source of distinctive competitive advantage, however, start-ups also need absorptive capacity – i.e., capacity to recognise valuable knowledge and integrate it into their products and services. Scientific institutions constitute an important source of research advances, and the Start-up sub-index therefore includes the WEF *Quality of research institutions*, which provides insight into the quality of a country's knowledge production system. To capture start-ups' ability to take advantage of research-based knowledge spillovers, we use the *Technicians and associate professionals* as a proxy derived from *International Labour Organisation (ILO)* database. This indicator measures the availability of the latest technology in a country and the absorptive capacity of business firms. We also use *Science in school* as an indicator derived from *IMD World Talent Ranking* report. This proxy measures how sufficiently science is emphasised

in schools.

To capture the digital aspect of knowledge creation, transfer, and absorption, we use *Employment in high tech and KIBs (Eurostat)* and *Software developers (Developer survey).* These indicators provide proxies of the degree to which the processes of knowledge creation, transfer and dissemination are digitalised.

Finance (S2_SEC_P3 and S2_SDC_P3)

Venture capital funding and other forms of equity investment are an important determinant of the risk-taking capacity of start-ups and therefore play an important and growing role in supporting the exploitation of as yet undiscovered and therefore risky entrepreneurial opportunities. The indicators chosen for the *Finance* pillar of the Start-up sub-index therefore measure different forms of formal and informal investment: (1) *Venture capital availability (WEF)*, (2) *Business angel investment (EBAN Statistics Compendium European Early Stage Market Statistics)* and (3) *Early phase VC (Venture Source, Dow Jones).*

As a digital proxy of start-up *Finance* pillar we used the *Alternative finance indicator* (1) *(Cambridge Centre)* which provides insight into new forms of alternative finance such as crowdfunding, peer-to-peer markets, invoice trading and debt-based securities triggered by the development of digital technologies and infrastructures. As a similar measure, we include two *Alternative finance* indicators (2, 3) offered by *The 3rd European Alternative Finance* Industry Report, and the *Alternative finance* (4) was used as a measure offered by the *Statista* database.

Support, networking (S2_SEC_P4 and S2_SDC_P4)

To progress from the Stand-up stage to the Start-up stage, a positive and supportive attitude towards domestic and international networks and collaborations is important. Among other things, and specific to the Start-up stage, such networks serve as a forum for cultivating and disseminating cluster-specific architectural knowledge on 'what works' in terms of business model design and facilitate horizontal sharing of knowledge regarding novel business model practices among start-ups (Autio, Cao, Chumjit, Kaensup, & Temsiripoj, 2019). Specific to this aspect, the *Enterprise Europe Network* offers a large online database of new business opportunities containing thousands of business, technology and research cooperation requests and offers from companies and research and development institutions.

As digital proxy of *Networking and Support* pillar, we used the *Accelerators (European Accelerators Report)* and the *Meetup Events (Tech Group Indicator MTGI, Tech Event Activity, MTEA) and members (Tech Member indicator MTMI, Tech Member Activity MTMA) (meetup.com)* indicators. These are distinctive structural elements of entrepreneurial ecosystems. The new venture accelerator phenomenon is largely driven by advances in digitalisation, and new venture accelerators have evolved beyond simple business-service providers or investment vehicles. Networking events bring together different participants of entrepreneurial ecosystems, facilitating their access to resources as well as dissemination of experiential knowledge regarding business model innovation.

Scale-up sub-index (S3)

Human capital (S3_SEC_P1 and S3_SDC_P1)

In order to scale, start-ups need both access to managerial knowledge and an ability to upgrade their workforce during the scale-up phase. Scale-up firms also need access to advanced managerial knowledge in order to build and run efficient organisations around their business models. Staff training and lifelong learning practices and institutions in a country are designed to constantly upgrade the skills of the labour force in order to adjust to technological progress and new economic opportunities. Management schools provide an important source of managerial skills. The *Human capital* pillar of the Scale-

up sub-index therefore includes proxies of these: (1) *Eurostat Lifelong learning,* (2) *WEF Extent of staff training,* (3) *IMD World Talent Ranking Skilled labor.* In addition to these supply-side indicators, and as a reflection of the ability of scale-ups to re-adjust their business models in the face of rapidly shifting opportunities characteristic of dynamic markets (including the possibility of reducing employment size when necessary), the *Labour Freedom* index from Heritage Foundation proxies this aspect. This index covers regulation relating to minimum wages, hiring and firing practices, hours of work, and severance requirements, among others.

Opportunity-driven scale-up entrepreneurs often leverage digital technologies and infrastructures when searching for information about market opportunities. Therefore, as digital proxies we use the *Eurostat* (1) *Internet use: finding information for goods and services* and (2) *Internet use: doing online course* indicators to capture the influence of digitalisation on conditions affecting entrepreneurial scale-up process.

Knowledge creation, transfer and absorption (S3_SEC_P2 and S3_SDC_P2)

Constant access to cutting-edge knowledge is important to fuel scale-ups. The *Knowledge Creation and Dissemination* pillar includes proxies of both knowledge inputs (in the form of the availability of knowledge-intensive human capital and investment in R&D) and outputs (in the form of patents). The *Eurostat GERD, Number of PCT patent applications* were selected as proxies of these.

Similar to start-ups, absorptive capacity is needed in order for business firms to translate knowledge inputs into distinctive products and services. As a proxy of these, we used the *Knowledge absorption (GII)* indicator.

In addition to knowledge production, knowledge accessibility is important for knowledge spill-overs to materialise. Accessing external sources of knowledge implies the need to participate in multi-stakeholder networks and knowledge-intensive collaborations with others, often as participants of innovation ecosystems. As proxies of these processes we included *(WEF) University-industry collaboration in R&D.*

Integrating digital technologies in business operations is an important determinant of scale-up ability due to the inherent scalability of many digital resources, as well as due to the potential of digital tools to support the coordination of complex operations. To this end, the EIDES Scale-up sub-index includes two indicators: the *Eurostat Enterprises who have ERP software* and the *Website has online ordering, reservation or booking* offered by *Eurostat*.

Finance (S3_SEC_P3 and S3_SDC_P3)

Access to finance is of obvious importance for scale-ups. The finance pillar of the EIDES Scale-up sub-index includes the *Later phase VC (Venture Source, Dow Jones)* and *Market capitalization (WEF)* indicators. In addition, the *European Private Equity* data source is the most comprehensive and authoritative source for European private equity fundraising, investment, and divestment data. Finally, the *Depth of Capital Market* is a complex index that measures the access to different capital markets by new ventures.

As noted previously, digitalisation has led to the introduction of many alternative financial instruments. The use of smartphones for mobile banking and investing services are examples of technologies aiming to make financial services more accessible to the general public. Financial technology companies consist of both start-ups and established financial and technology companies trying to replace or enhance financial services provided by existing financial companies. *Dealroom.co Fintech* indicator measures the number of financial technology businesses.

Support, networking (S2_SEC_P4 and S2_SDC_P4)

Scale-ups need resource munificent environments to grow their operations, ones that are rich in the kind of specialised resources and business infrastructure they rely on. In order to capture this aspect, the networking and support pillar of the EIDES scale-up

sub-index includes one indicator of cluster development, one indicator of business sophistication, and one indicator of the quality of the physical business infrastructure. Clusters provide good access to sophisticated resources and to beneficial demand and supply conditions. The business sophistication indicator provides insight into the quality of potential partners. The logistic index provides an indication of the quality of the physical infrastructure: (1) *State of cluster development (WEF),* (2) *Multi-stakeholder collaboration (WEF)* and (3) *Logistic index*.

Both domestic and international logistics are central to economic growth and competitiveness of countries. Efficient logistics connects firms to domestic and international markets in a reliable and cost-efficient manner. Conversely, businesses in countries characterised by low logistics performance face high costs, not merely because of transportation costs, but also because of unreliable supply chains, a major handicap in integrating and competing in global value chains.

Business sophistication is conducive to higher efficiency in the production of goods and services. The quality of a country's business networks and supporting industries, as measured by the quantity and quality of local suppliers and the extent of their interaction, is important for a variety of reasons. When companies and suppliers from a particular sector are interconnected in geographically proximate clusters, efficiency is enhanced, opportunities for innovation are opened, and barriers to entry for new firms are reduced. Individual firms' operations and strategies (branding, marketing, the presence of a value chain, and the production of unique and sophisticated products) all support modern, sophisticated business processes.

The digital aspect of the networking and support pillar captures the effect of digital infrastructures and technologies on networking. The (1) *Enterprises whose business processes are automatically linked to those of their suppliers and/or customers*, (2) *Enterprises using software solutions, like CRM to analyse information about clients for marketing purposes*, and (3) *Total investment in networks by the electronic communications sector* indicators provide insight into what extent businesses in a given country rely on digital solutions in their interactions with other businesses and consumers.

5 EIDES Results

5.1 Country Rankings

The 2019 EIDES index for the EU28 countries is shown in Table 3. The table shows the digitalised versions of the index for the three sub-systems – i.e., the stand-up system, the start-up system and the scale-up system. These sub-indices represent a combination of the general framework conditions and the sub-index score for each of the three sub-systems, as composed of systemic framework conditions. The rightmost column shows the overall EIDES score, which represents the arithmetic average of the three sub-index scores. The range for all scales is from 0 (lowest) to 100 (highest).

We divide the countries into four groups: leaders (EIDES score above 60), followers (EIDES score above 45 and up to 60), catchers-up (EIDES score above 35 and up to 45) and laggards (EIDES score below 35). The four groups are highlighted using different colours. These cut-off points emerge naturally from the data, as shown in Figure 2.

In the 2018 EIDES ranking, seven countries emerge as leaders in terms of their digitalised general and systemic framework conditions for entrepreneurship. These are: Sweden, Denmark, The Netherlands, United Kingdom, Finland, Germany, and Luxembourg. Of these, Sweden and Denmark are virtually even in terms of their overall EIDES score. Sweden ranks first for two out of the three sub-systems (start-up and scale-up). Denmark ranks first for stand-up and second for scale-up and third for start-up systems. Netherlands scores 3rd for the stand-up and scale-up systems and 5th for start-up.

After the group of seven leading countries, there is a gap of seven index score points to the second group, followers. This group comprises seven countries: Ireland, Belgium, Austria, Estonia, France, Malta, and Spain. Of these, Ireland, Belgium are ahead of Austria, Estonia, and France while Malta and Spain rank at the bottom of this group.

The catchers-up group comprises six countries: Czech Republic, Lithuania, Slovenia, Portugal and Cyprus. The EIDES scores for this group range from 35,2 (Poland) to 43,9 (Czech Republic), which is clearly behind the leader group, whose index scores average above 70.

Finally, the group of laggards comprises eight countries:, Italy, Hungary, Latvia, Slovakia, Croatia, Romania, Greece and Bulgaria. It is notable that Italy is ranked in this group, in spite of being one of the G7 countries. Other than Italy, this group comprises former centrally planned economies and Greece.

Several patterns are notable in this grouping. The Nordic EU28 countries all rank in the leader group. The follower group comprises mostly Western European countries plus Malta and Estonia – the latter being the only former centrally planned economy to rank in the top half of the ranking. The catchers-up group includes a mix of Southern European and new Member States. The follower group includes the new EU Memebr States plus Italy and Greece.

Table 3. EIDES Digital Scores for EU28 countries

Country	Stand-up System		Start-up System		Scale-up System		EIDES	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Sweden	77,0	2	73,3	1	78,3	1	76,2	1
Denmark	79,1	1	70,1	3	76,1	2	75,1	2
Netherlands	75,2	3	66,8	5	74,5	3	72,2	3
United Kingdom	71,4	4	70,6	2	72,7	4	71,5	4
Finland	71,4	5	67,8	4	69,2	5	69,5	5
Germany	67,9	7	66,7	6	68,6	6	67,8	6
Luxembourg	68,1	6	65,4	7	67,0	7	66,8	7
Leaders	**72,9**		**68,7**		**72,3**		**71,3**	
Ireland	58,7	8	60,2	8	58,3	9	59,1	8
Belgium	58,4	9	56,1	9	58,8	8	57,8	9
Austria	53,3	11	53,2	11	55,2	10	53,9	10
Estonia	54,2	10	53,3	10	49,5	12	52,4	11
France	50,4	12	52,6	12	52,5	11	51,8	12
Malta	46,9	13	51,1	13	47,4	13	48,5	13
Spain	46,5	14	47,2	14	45,2	14	46,3	14
Followers	**52,6**		**53,4**		**52,4**		**52,8**	
Czech Republic	43,6	15	44,3	15	43,7	15	43,9	15
Lithuania	42,3	16	42,7	16	41,5	16	42,2	16
Slovenia	38,3	17	42,4	17	39,1	17	39,9	17
Portugal	37,6	18	37,0	19	36,6	18	37,1	18
Cyprus	36,7	19	38,6	18	35,4	20	36,9	19
Poland	33,4	20	36,7	20	35,5	19	35,2	20
Catchers-up	**38,7**		**40,3**		**38,6**		**39,2**	
Italy	33,3	21	35,6	22	34,8	22	34,6	21
Hungary	31,5	23	35,7	21	34,8	21	34,0	22
Latvia	32,4	22	35,0	23	34,0	23	33,8	23
Slovakia	30,5	24	33,0	24	31,3	24	31,6	24
Croatia	27,2	25	30,7	25	28,3	25	28,7	25
Romania	26,6	26	27,4	26	27,4	26	27,1	26
Greece	24,8	27	27,3	27	24,5	28	25,5	27
Bulgaria	23,9	28	26,1	28	24,8	27	24,9	28
Laggards	**28,8**		**31,4**		**30,0**		**30,0**	
EU28 average	**48,0**		**48,0**		**48,0**		**48,0**	

Figure 2. Country Groupings for EIDES 2019

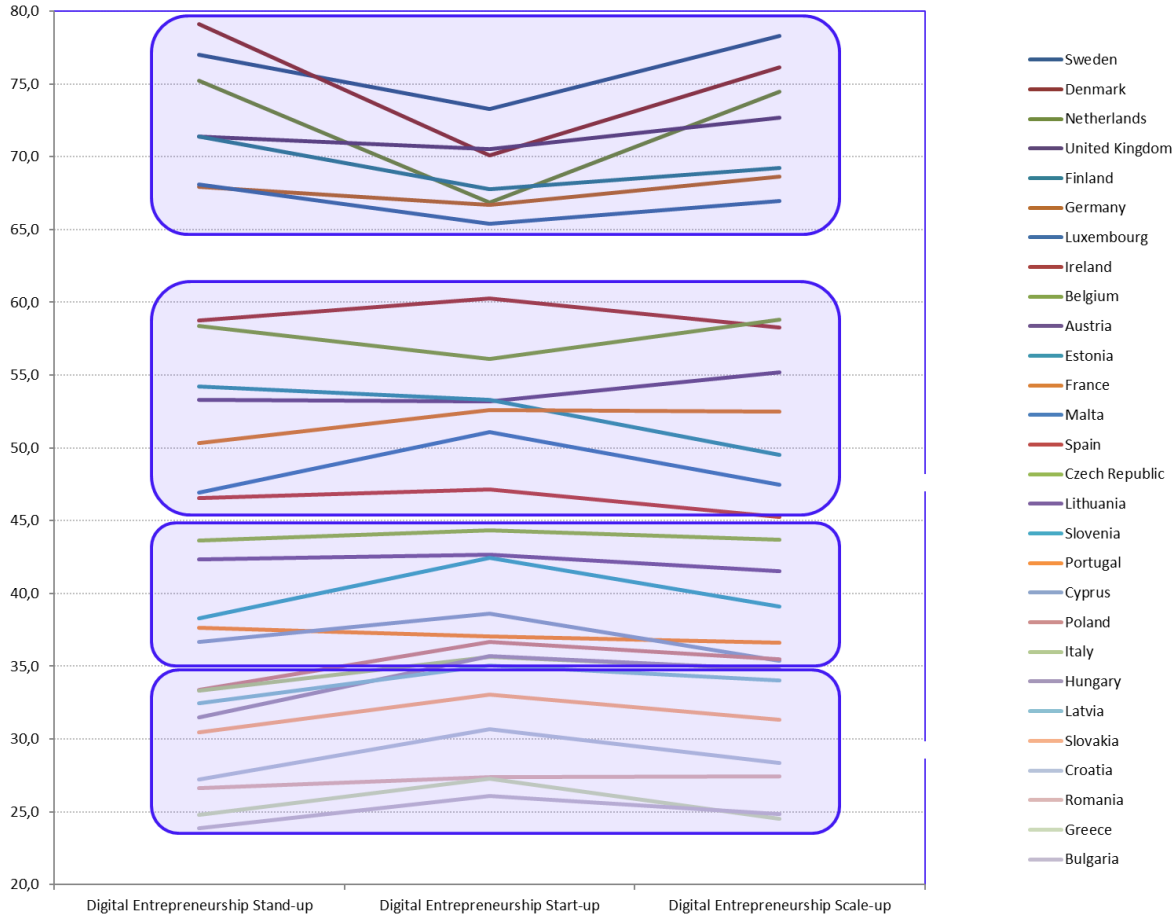


Figure 3 shows the EIDES profiles of the four country groups in terms of their average performance for the eight index pillars that represent general and systemic framework conditions. For the systemic conditions, the combined score of the three sub-systems is shown.

Figure 3. EIDES Profiles of the Four Country Groups

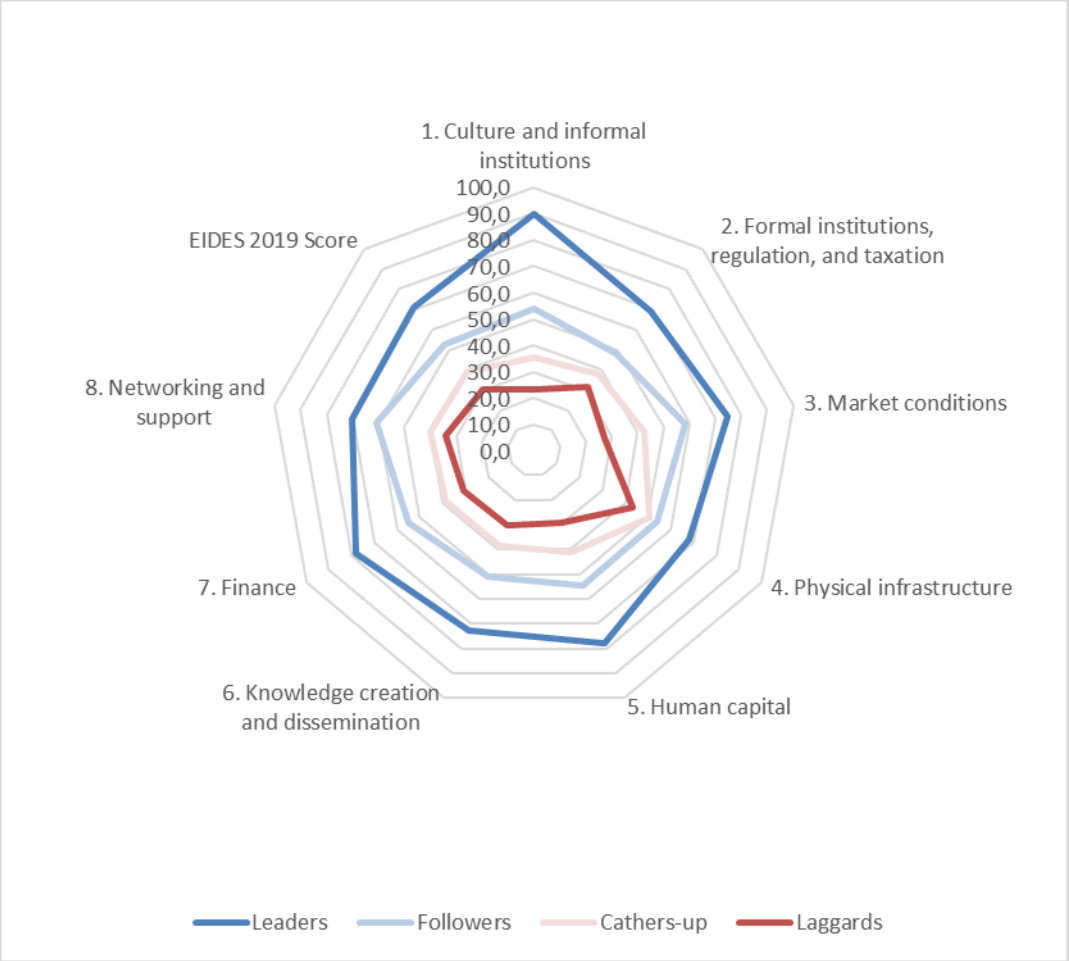


Table 4 shows individual pillar values for the EU28 countries, grouped by leaders, followers, catchers-up and laggards. This table allows a more close-up inspection and comparison of the profiles of different countries[4]. Several interesting observations can be made:

- For the culture and informal institutions pillar, the Netherlands and Nordic Member States stand out for the most positive culture among the EU28 and as the only countries with pillar values above 0,9 (The Netherlands posting a perfect 1,0)
- For the formal institutions, regulation and taxation pillar, Luxembourg stands out in a category of its own as the country with the most friendly regulation and taxation system
- For market conditions, large countries tend to exhibit higher scores because of their larger domestic markets. But Sweden and Denmark stand out in spite of their relative smaller domestic market, ranking alongside the UK and Germany. The Czech Republic is performing well in the Catchers-up group
- For the physical infrastructure pillar, many Cathing-up countries post scores that are higher than their overall EIDES score (Czech Republic, Lithuania, Slovenia, Portugal) and ahead of, e.g., Ireland and France
- For the human capital pillar, Finland ranks ahead of the other countries, followed by Sweden and Denmark

[4] Two-page close-ups of each EU28 country are provided in the country pages (Chapter 6)

— For the knowledge creation and dissemination pillar, Germany ranks on top, followed by The Netherlands and Sweden. The Czech Republic stands out among the bottom half of the EIDES ranking

— For the finance pillar, the UK ranks first among the EU28 countries. Latvia ranks significantly ahead of its overall EIDES ranking, as does Estonia, whereas Austria lags significantly behind its overall EIDES ranking

— For the support and networking pillar, Luxembourg leads the pack. Ireland ranks significantly ahead of its overall EIDES ranking, whereas Finland ranks significantly behind. Italy scores its best ranking for this pillar. Also Spain and Malta post high networking scores relative to their overall EIDES score

Table 4. Pillar values of the EIDES

Country	Culture and informal institutions	Formal institutions, regulation and taxation	Market conditions	Physical infra-structure	Human capital	Knowledge creation and dissemi-nation	Finance	Networking and support	EIDES 2019 score
Sweden	93,4	68,8	92,1	62,0	94,3	78,0	78,6	63,9	76,2
Denmark	94,9	68,3	88,9	75,0	79,8	68,9	68,0	77,5	75,1
Netherlands	100,0	63,0	66,0	93,9	75,8	80,2	81,3	67,4	72,2
United Kingdom	88,7	65,6	89,5	64,7	76,4	66,3	98,2	62,3	71,5
Finland	94,6	68,8	54,3	53,8	98,3	71,9	81,9	59,3	69,5
Germany	81,0	61,6	85,3	70,5	58,7	91,1	54,8	64,1	67,8
Luxembourg	78,0	86,2	47,8	55,6	63,7	51,1	83,7	97,4	66,8
Leaders	**90,1**	**68,9**	**74,8**	**67,9**	**78,1**	**72,5**	**78,1**	**70,3**	**71,3**
Ireland	63,7	54,2	80,6	48,6	56,3	49,1	53,0	83,3	59,1
Belgium	59,9	44,2	87,8	51,8	55,0	56,9	55,9	64,5	57,8
Austria	64,9	55,1	37,9	80,7	56,4	63,1	43,3	48,1	53,9
Estonia	54,3	52,2	38,8	64,9	64,3	42,5	68,2	47,9	52,4
France	51,4	44,2	59,9	41,2	47,3	66,0	57,5	55,7	51,8
Malta	44,5	54,0	56,0	35,0	52,2	35,9	61,8	64,2	48,5
Spain	39,0	35,1	48,4	56,6	50,3	42,7	46,1	61,0	46,3
Followers	**54,0**	**48,4**	**58,5**	**54,1**	**54,6**	**50,9**	**55,1**	**60,7**	**52,8**
Czech Republic	45,0	30,9	71,3	57,7	43,6	53,8	36,7	32,5	43,9
Lithuania	38,1	37,9	46,1	58,5	42,4	32,4	42,7	47,0	42,2
Slovenia	37,7	39,0	40,6	54,2	48,8	47,3	28,7	35,9	39,9
Portugal	26,2	39,1	32,9	51,7	41,6	33,4	35,3	43,9	37,1
Cyprus	34,0	47,4	21,5	43,9	37,9	28,0	51,2	46,3	36,9
Poland	30,5	33,6	42,3	37,0	33,2	35,7	36,7	34,1	35,2
Cathers-up	**35,3**	**38,0**	**42,5**	**50,5**	**41,2**	**38,4**	**38,6**	**39,9**	**39,2**
Italy	23,4	31,3	37,7	40,8	30,0	45,7	29,9	45,8	34,6
Hungary	23,2	27,0	40,4	60,7	33,0	38,3	32,1	32,0	34,0
Latvia	31,0	35,2	22,3	48,0	37,4	24,7	49,5	32,2	33,8
Slovakia	29,8	25,0	39,7	34,6	29,9	36,5	31,4	29,7	31,6
Croatia	19,5	35,8	28,2	38,1	27,2	24,0	29,8	34,6	28,7
Romania	20,2	35,4	15,1	63,5	22,8	22,6	22,2	29,8	27,1
Greece	20,2	29,5	23,5	20,7	32,5	24,3	24,9	30,6	25,5
Bulgaria	16,8	33,4	11,0	41,0	21,9	24,8	25,2	38,1	24,9
Laggards	**23,0**	**31,6**	**27,2**	**43,4**	**29,3**	**30,1**	**30,6**	**34,1**	**30,0**
EU28 average	**50,1**	**46,5**	**50,2**	**53,7**	**50,4**	**47,7**	**50,3**	**51,0**	**48,0**

We can compare the changes in EIDES scores and rankings from 2018 to 2019 (Table 5). Note that we had to recalculate the 2018 EIDES scores in the new structure due to changed data content to ensure comparability. This means that the 2018 EIDES scores in Table 5 are not directly comparable with the scores published in the EIDES 2018 index report. See for Chapter 4for details.

Table 5. Changes in the EIDES scores and ranking 2018-2019

Country	EIDES 2019		EIDES 2018		Change in Score	Change in Rank
	Score	Rank	Score	Rank		
Sweden	76,2	1	71,2	2	5,0	1
Denmark	75,1	2	75,7	1	-0,6	-1
Netherlands	72,2	3	68,5	4	3,6	1
United Kingdom	71,5	4	71,1	3	0,4	-1
Finland	69,5	5	64,3	7	5,2	2
Germany	67,8	6	65,4	5	2,4	-1
Luxembourg	66,8	7	65,1	6	1,7	-1
Ireland	59,1	8	54,8	9	4,3	1
Belgium	57,8	9	55,6	8	2,1	-1
Austria	53,9	10	51,0	10	2,9	0
Estonia	52,4	11	48,4	11	3,9	0
France	51,8	12	48,0	12	3,8	0
Malta	48,5	13	47,9	13	0,6	0
Spain	46,3	14	42,1	14	4,2	0
Czech Republic	43,9	15	41,7	15	2,2	0
Lithuania	42,2	16	40,1	16	2,0	0
Slovenia	39,9	17	36,8	17	3,2	0
Portugal	37,1	18	34,7	18	2,3	0
Cyprus	36,9	19	34,0	19	2,9	0
Poland	35,2	20	33,6	20	1,5	0
Italy	34,6	21	32,8	21	1,8	0
Hungary	34,0	22	28,2	24	5,8	2
Latvia	33,8	23	31,3	23	2,5	0
Slovakia	31,6	24	32,4	22	-0,7	-2
Croatia	28,7	25	27,8	25	1,0	0
Romania	27,1	26	22,8	28	4,3	2
Greece	25,5	27	25,0	26	0,5	-1
Bulgaria	24,9	28	23,1	27	1,9	-1
EU28 Average	**48,0**		**45,5**		**2,5**	
EU28 Max	**76,2 (Sweden)**		**75,7 (Denmark)**		**5,8 (Hungary)**	
EU28 Min	**24,9 (Bulgaria)**		**22,8 (Romania)**		**-0,7 (Slovakia)**	

*EIDES 2018 scores were recalculated in the new structure. These scores and rankings cannot be directly compared to our previous 2018 EIDES scores and ranking.

According to Table 55, the average EIDES scores improved from 45,5 to 48,0, a 5,6 percent change. While the change in the maximum EIDES score is only 0,5 at the top, it is 2,1 at the bottom, signalling that Laggards improved more than the Leaders. Only two of the EU28 countries got a lower EIDES score. Denmark's EIDES score retreated by 0,6 index points, so this country dropped from the first place to the second. Slovakia's EIDES score decreased by 0,7 index points, and the country dropped two places in the EU28 ranking. Some countries changed group membership: Spain moved into the Followers group, and Portugal, Cyprus, and Poland moved to the Catchers-up group. The largest improvement, over 5 EIDES points each, is achieved by three countries - Hungary (5,8 points), Finland (5,2 points), and Sweden (5,0 points) - which all improved their ranking by 2 places. Romania and Ireland improved both by 4,3 points, and Spain by 4,2

points. At the same time the United Kingdom, Malta and Greece posted only marginal improvements.

5.2 Comparison Between EIDES and Other Measures of Country-Level Entrepreneurship

How does the EIDES compare with a country's GDP per capita and country-level measures of entrepreneurial activity? We compare EIDES against GDP per capita to check if there is any top-level association between the two. We also explore top-level associations between EIDES and the ESIS (Van Roy and Nepelski, 2016). For entrepreneurial attitude and activity measures, we explore associations between measures of preferences for self-employment, for self-employment in general, as well as measures of growth-oriented entrepreneurship, high-growth performance and the importance of 'modern' start-ups.

The EIDES scores exhibit a positive association with a country's GDP per capita (see Figure 4). The coefficient for the bivariate correlation – without the outlier Luxembourg - is 0,79 and 'variance explained' in this bivariate association (i.e., the R^2 score) is 0,63. This association is not surprising and should not be interpreted as indicating a causal effect. This is because wealthy economies will have more resources and will be able to better invest in the kinds of infrastructures and institutions that are captured in the EIDES. In this association, the outlier is Luxembourg due to its high per-capita GDP.

Figure 4. Correlation between EIDES Scores and GDP Per Capita (Luxembourg not included in the correlation but shown in the graph)

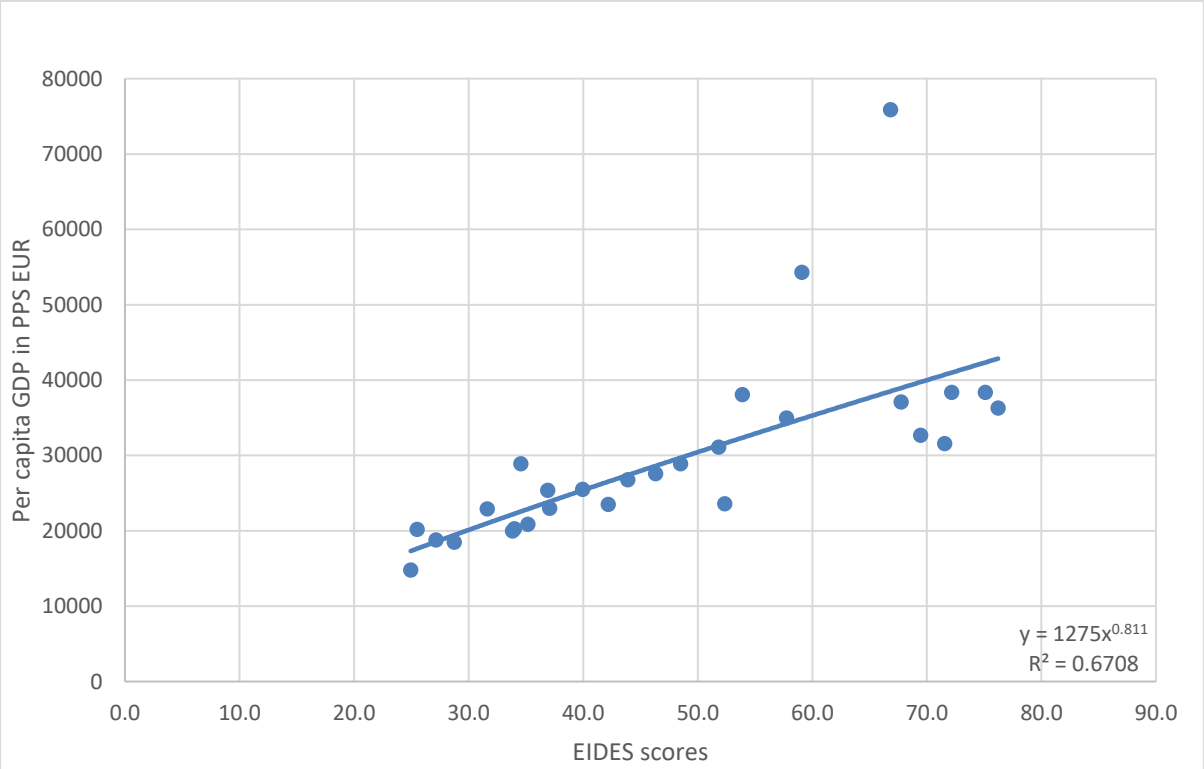


Table 5 shows bivariate correlations between the EIDES, its sub-indices, and the two ESIS indices. The strong correlations between EIDES and its sub-indices are a direct consequence of the index methodology. Not surprisingly, the EIDES and its sub-indices also correlate strongly with the two sub-indices of the ESIS which is built according to a similar methodology.

Table 5. Correlations between EIDES and ESIS

		1	2	3	4	5	6
1	EIDES	1,000	,998**	,996**	,998**	,887**	,913**
2	EIDES Stand-up		1,000	,991**	,996**	,894**	,913**
3	EIDES Start-up			1,000	,992**	,876**	,918**
4	EIDES Scale-up				1,000	,884**	,903**
5	ESIS Entrepreneurship Index					1,000	,851**
6	ESIS Scale-up Index						1,000

** Correlation is significant at the 0,01 level (2-tailed)

Table 6 shows the correlation coefficients between EIDES and various entrepreneurial outcome measures. We can see that the EIDES scores tend to correlate negatively with measures reflecting self-employment or the preference for it. Notably, there is a strong negative bivariate association between the EIDES score and the population preference for self-employment as a career choice, as reported in the 2012 Flash Eurobarometer report. EIDES also correlates negatively with the prevalence of self-employment activity in the economy. These correlations are consistent with the notion that self-employment activity is not like the ambitious and growth-oriented entrepreneurial activity. There are qualitative differences among forms of self-employment, small business, and entrepreneurial activity, with only a small proportion of new firms contributing disproportionately to economic growth (Birch, Haggerty, & Parsons, 1997; OECD, 2010). It is notable that also the GEM-based measures of overall entrepreneurial activity (i.e., the GEM 'TEA' measure) shows no correlation and GEM's high-growth aspiration measure correlate negatively, although not statistically significantly, with the EIDES score. This may reflect the high share of self-employment activity in GEM data.

The only positive associations for the EIDES score are shown for the share of high-growth enterprises among businesses employing 10 or more employees (not statistically significant) and the start-up ranking score (statistically significant). The start-up ranking score is maintained by startupranking.com, and it provides a proxy of the start-up's visibility in the Internet and social media. The advantage of this ranking is that it focuses on 'modern' start-ups, defined as: *"An organization with high innovation competence and strong technological base, which has the faculty of an accelerated growth and maintains independence through time. The max lifespan should be of 10 years."* This definition fits well the population of start-ups that inhabit new venture accelerators and constitute the target group of the EIDES[5]. For calculating the start-up ranking score, we used the global visibility score of the top 10% of registered start-ups for each country, standardised by population size. The positive correlation between the EIDES score and the start-up ranking score suggests an association between EIDES and the visibility of the country's start-ups in the global start-up community.

[5] The downside of the start-up ranking is that it is not a random sample, but rather, based on the self-registration by businesses that self-identify as start-ups that fit the ranking's criteria.

Table 6. Bivariate Correlations between EIDES and Entrepreneurial Outcome Measures

		1	2	3	4	5	6	7
1	EIDES	1,000	-,757**	-,430*	0,090	-0,017	0,242	,400*
2	Preference for self-employment (2012)[6]		1,000	0,304	-0,030	0,071	-0,190	-0,255
3	Self -employment (2016-2018 average)[7]			1,000	-0,273	-0,344	-0,227	-,409*
4	TEA (2016-2018 average)[8]				1,000	0,412	0,107	,447*
5	TEA high-growth aspiration (2016-2018)[9]					1,000	0,393	0,177
6	Share of high-growth enterprises (2014-2017 average)[10]						1,000	,388*
7	Start-up ranking score, top ten percent, weighted by population (2019)[11]							1,000

** Correlation is significant at the 0,01 level (2-tailed)

* Correlation is significant at the 0,05 level (2-tailed)

We also explored associations between the EIDES and other indices that estimate the quality of the framework conditions for innovation, entrepreneurship, and competitiveness in general. These correlations are shown in Table 7. All the indices compared correlate positively with each other and the EIDES. Since all these indices use exclusively or mostly closely correlated institutional variables, this is not surprising. Note that the reason for building different framework indices, even if highly correlated, is not to measure development in general but to highlight different aspects of development potential. Although these are generally positively associated with one another, the differences between different aspects can be informative. Note that the EIDES also correlates strongly with the only index of national systems of entrepreneurship, the Global Entrepreneurship Index.

6 Preference for self-employment is from the Flash Eurobarometer 354 Report (Entrepreneurship in the EU and Beyond), p. 16. http://ec.europa.eu/commfrontoffice/publicopinion/flash/fl_354_en.pdf

7 Self-employment data are from the World Bank database, https://data.worldbank.org/indicator/SL.EMP.SELF.ZS

8 TEA is The Total early-stage Entrepreneurial Activity measure of the Global Entrepreneurship Monitor dataset, http://gemconsortium.org/data

9 High grwth expectations is the "Percentage of those involved in TEA who expect to create 6 or more jobs in 5 years". (http://gemconsortium.org/data)

10 Share of high-growth enterprises measured in employment: number of high-growth enterprises divided by the number of active enterprises with at least 10 employees – percentage (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=bd_9pm_r2&lang=en)

11 Start-up ranking score reflects the importance of a startup on the internet and its social influence. It is calculated based on SR Web and SR Social. Data are calculated from Startupranking websitehttps://www.startupranking.com/countries

Table 7. Bivariate Correlations between EIDES and Framework Indices

		1	2	3	4	5	6
1	EIDES	1,000	,943**	,952**	,927**	,961**	,935**
2	Global Competitiveness Index (2018-2019)[12]		1,000	,933**	,821**	,918**	,911**
3	Global Innovation Index (2018)[13]			1,000	,882**	,910**	,904**
4	Digital Economy and Society Index (2019)[14]				1,000	,919**	,871**
5	Networked Readiness Index (2016)[15]					1,000	,930**
6	Global Entrepreneurship Index (2012-2016 average)[16]						1,000

** Correlation is significant at the 0,01 level (2-tailed)

* Correlation is significant at the 0,05 level (2-tailed)

12 Global Competitiveness Index score is the World Economic Forum's flagship product, measuring presents a framework and a corresponding set of indicators in three principal categories (subindexes) and twelve policy domains (pillars) for the economies. present data are from the 2017-2018 edition. (https://www.weforum.org/reports/the-global-competitiveness-report-2017-2018)

13 Global Innovation Index score is from the Global Innovation Index 2017 INSEAD report. measuring various aspect of the innovation system. Data are from the 2017 issue (https://www.globalinnovationindex.org/)

14 Digital Economy and Society Index is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU Member States in digital competitiveness (https://ec.europa.eu/digital-single-market/en/desi). We used the most recent 2017 data.

15 Networked Readiness Index (NRI) scores are from the World Economic Forum Global information Technology Report. NRI is a tool assessing countries' preparedness to reap the benefits of emerging technologies and capitalize on the opportunities presented by the digital transformation and beyond. (http://reports.weforum.org/global-information-technology-report-2016/1-1-the-networked-readiness-index-2016/)

16 Global Entrepreneurship Index is a measure of countries' entrepreneurship system in fourteen categories by combining both the individual and the institutional aspects of potentially high impact startups. Data are from the 2011-2015 GEI reports and GEDI dataset (http://thegedi.org/downloads/)

6 Country Pages

6.1 Country Page Guide

1. **General information** starts with the official country name, followed by population size (millions, average for years 2016-2018) and GDP per capita (purchasing power parity based on euro averages for years 2015-2017). This data was retrieved from the Eurostat database[17] on the 31st of May 2019.
2. **Performance overview** provides the country's overall performance in EIDES.
3. **Country group** indicates the country's performance relative to others, grouped in four categories:
    - Laggards (EIDES score below 35)
    - Catchers-up (35 < EIDES score ≤45)
    - Followers (45 < EIDES score ≤ 60)
    - Leaders (EIDES score over 60)
4. **EIDES rank** is the country's EIDES ranking among the EU28 countries.
5. **EIDES score** is the EIDES overall index score on a scale from 0 (low) to 100 (high).
6. **The three sub-indices** show the country's EU28 ranking and the country's score (in parentheses) for each of the three sub-indices: the Digital Entrepreneurship Stand-up sub-index, the Digital Entrepreneurship Start-up sub-index, and the Digital Entrepreneurship Scale-up sub-index. Sub-index scores are on a scale from 0 to 100 index points.
7. **EIDES profile** is a spider diagram that shows the performance of each country for the eight EIDES pillars. The country performance is compared against the average pillar scores of each country group. For individual countries in the Leader and the Follower groups, the country's pillar score is compared against the Leader and Follower group averages. For countries in the Catchers-up group, the country's pillar score is compared against the Follower and Catchers-up group averages. For countries in the Laggards group, the country's pillar score is shown against the group averages for the Catchers-up and the Followers groups. All scales are from 0 to 100.
8. **Pillar performance.** Below the EIDES profile diagram we show the country's scores for its strongest and weakest index pillar (in parentheses). Pillar scores are from 0 to 100.
9. **EIDES pillar and component values**. On page two of the individual country reports we present the pillar values for each of the eight EIDES pillars. We also list the non-digitalised value of the pillar ('non-digital score'), as well as the value of the digitalisation parameter ('digital'). It is important to recognise that the scores of individual pillar components are NOT the result of a simple multiplication of the non-digital (i.e., 'non-digital score') and the digital (i.e., 'digital') components. The EIDES pillar scores are calculated from 'raw' values. In columns 'non-digital score' and 'digital' we report normalised and average adjusted values for the respective pillar components. The colours in each cell of the table denote the quartile within which the country is grouped for each component. Dark blue colour of the cell indicates the top quartile; light blue the second quartile; light brown the third quartile; and dark brown the bottom quartile.

[17] http://ec.europa.eu/eurostat/data/database

(a) **Pillar**: In the first column we list the eight pillar names and the three sub-index names as well as the EIDES score.

(b) **Pillar score** column shows the country's pillar scores on a 0-100 point scale.

(c) **Non-digital score** column shows the country's non-digitalised pillar scores. The calculation of these scores is described in Annex 1 (scale from 0 to 100).

(d) **Digital** column shows the digital component scores on a scale from 0 to 100. The calculation of these scores is described in Annex 1.

(e) **EIDES score** shows the overall index score, as well as the scores for non-digital and digital components on a scale from 0 to 100.

(f) **Sub-index scores** are shown for each of the digital entrepreneurship sub-indices on a scale from 0 to 100. Colour codes are as described above.

10. **Policy optimisation simulation**. Finally, we present a policy optimisation simulation for each country. This simulation informs on the 'optimal' allocation of policy attention and policy resources for improving the country's EIDES performance. This simulation assumes that the country's entrepreneurial dynamic is held back most by its 'weakest', or 'bottleneck' pillar – i.e., the pillar with the lowest pillar score. Under this assumption, the 'optimal' allocation of policy resources should always target the weakest pillar first. Once the individual pillar performance has improved such that the pillar no longer constitutes a bottleneck, policy attention should shift to focus on the second weakest pillar, and so on. An 'optimal' policy therefore systematically and dynamically addresses 'bottleneck' pillars until the desired improvement in the EIDES score has been achieved.

    This simulation assumes that the marginal cost of performance improvement is the same for each index pillar. Because of this simplifying assumption, the scenario shown in the policy optimisation simulation should NOT be taken as prescriptive. Instead, the simulation simply suggests potential bottlenecks in each country's digital entrepreneurship system, providing material for policy debates.

    In the simulation, we have set the target for each country as reaching a 10% increase in the EIDES score. The graph then shows the 'optimal' allocation of policy resources across the four General Framework Condition Pillars (GFC) and the twelve Systemic Framework Condition Pillars (SFC; remember that separate SFC pillar values are calculated for the stand-up, start-up, and scale-up stages, creating a total of 12 SFC pillar values).

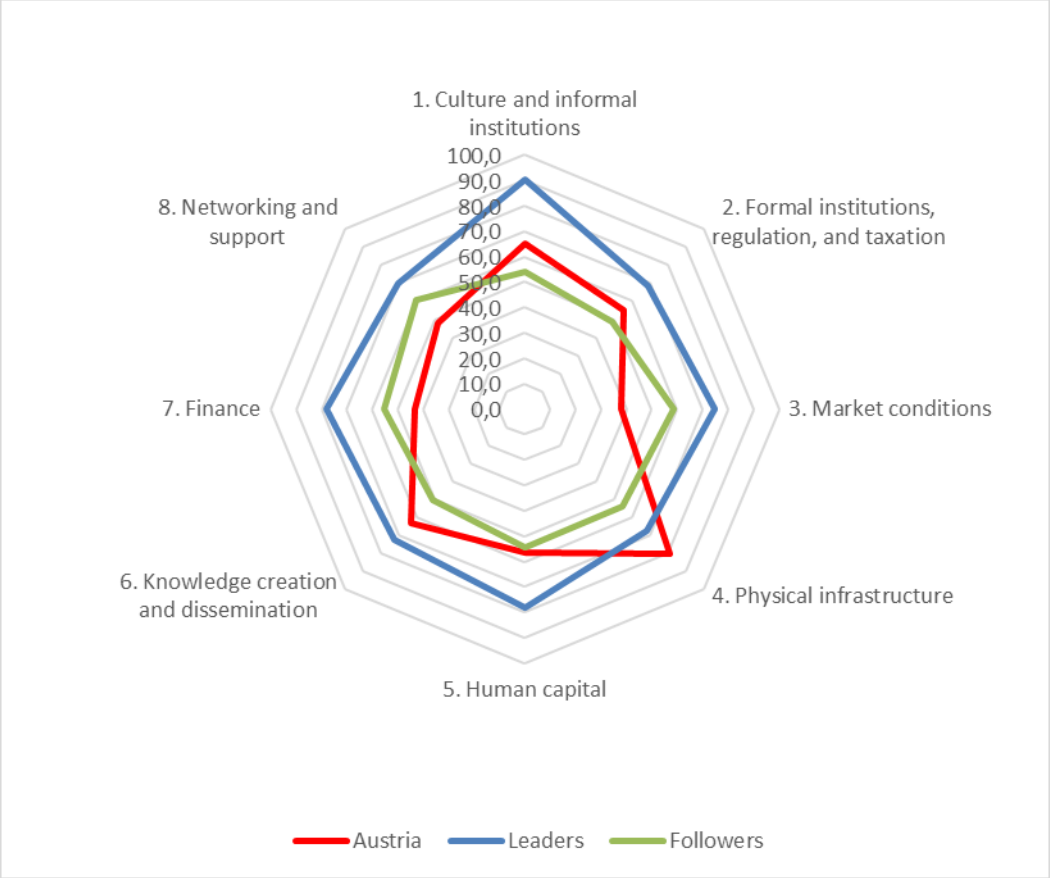
11. **Sum of additional resources** (in unit per population): Below the policy simulation table we report the sum of the addition units that is required to reach a 10 point increase in the EIDES score. While the monetary value of the unit is unknown, its magnitude reflects to the amount of additional money required for the 10 point EIDES score increase. This value is expressed in unit per population. The additional unit for this 10% increase ranges from 12,0 (Romania) to 96,0 (Denmark).

6.2 Country Profiles

6.2.1 Austria

Size of population 2016-2018 (in Millions)	8,8
Per capita GDP in Euro 2015-2017 average (PPP)	37 733
Country group	Followers
EIDES rank (score)	10 (53,9)
Digital Entrepreneurship Stand-up sub-index rank (score)	11 (53,3)
Digital Entrepreneurship Start-up sub-index rank (score)	11 (53,2)
Digital Entrepreneurship Scale-up sub-index rank (score)	10 (55,2)

Figure 5. Austria's position in the eight EIDES pillars

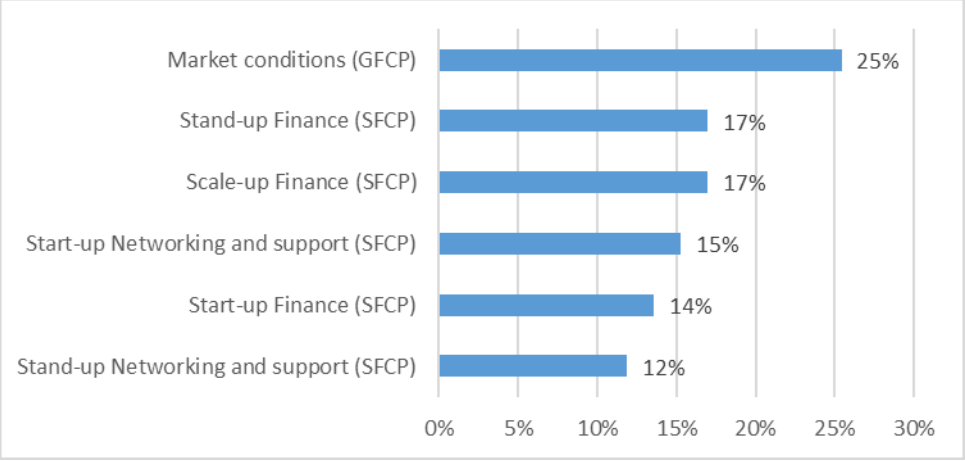


Weakest pillar	Market conditions (37,9)
Strongest pillar	Physical infrastructure (80,7)

Table 8. Austria's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Frame-work Conditions	Culture, informal institutions	64,9	84,2	78,1
	Formal institutions, regulation, taxation	55,1	72,4	71,9
	Market conditions	37,9	67,3	60,2
	Physical infrastructure	80,7	95,1	83,6
Systemic Frame-work Conditions	Human capital	56,4	69,2	69,8
	Knowledge creation and dissemination	63,1	73,0	69,8
	Finance	43,3	38,9	61,8
	Networking and support	48,1	68,9	65,6
EIDES SCORE		**53,9**	**71,1**	**70,1**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	53,3		
	Digital Entrepreneurship Start-up	53,2		
	Digital Entrepreneurship Scale-up	55,2		

Table 9. Austria's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

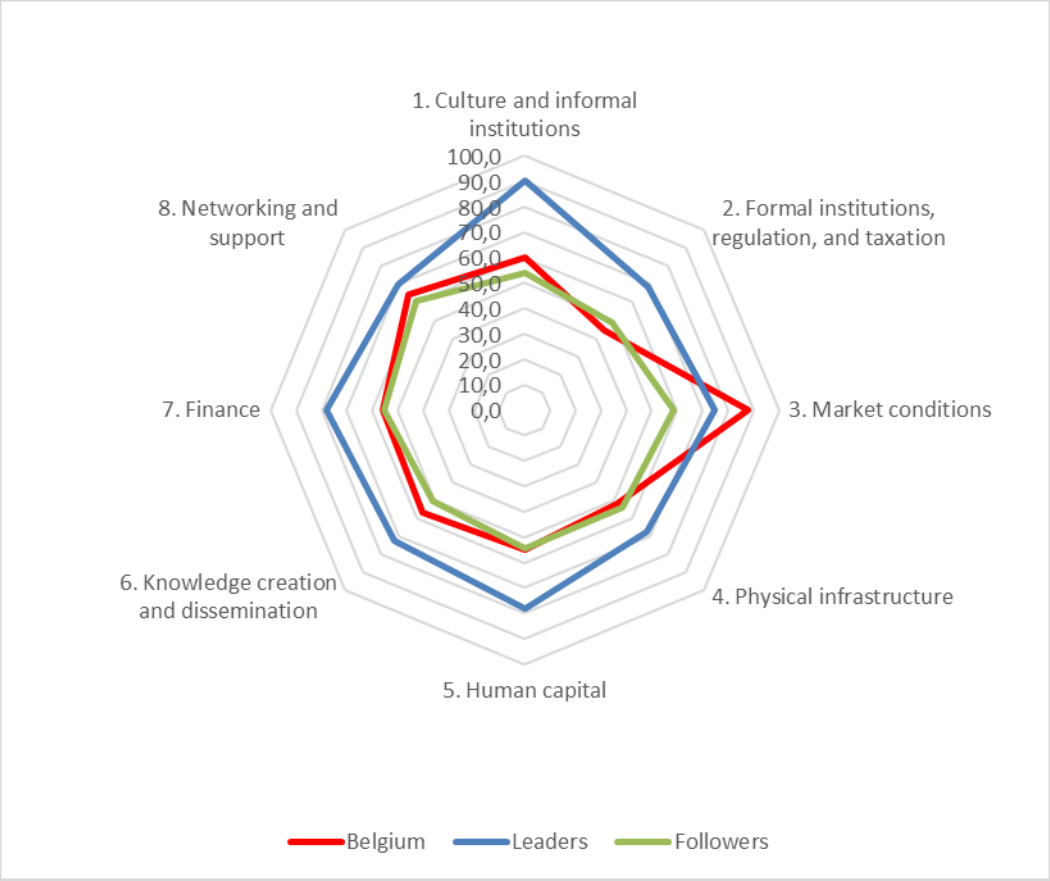


Sum of additional resources for 10% EIDES score increase (in unit per population) 58,6

6.2.2 Belgium

Size of population 2016-2018 (in Millions)	11,4
Per capita GDP in Euro 2015-2017 average (PPP)	34 633
Country group	Followers
EIDES rank (score)	9 (57,8)
Digital Entrepreneurship Stand-up sub-index rank (score)	9 (58,4)
Digital Entrepreneurship Start-up sub-index rank (score)	9 (56,1)
Digital Entrepreneurship Scale-up sub-index rank (score)	8 (58,8)

Figure 6. Belgium's position in the eight EIDES pillars

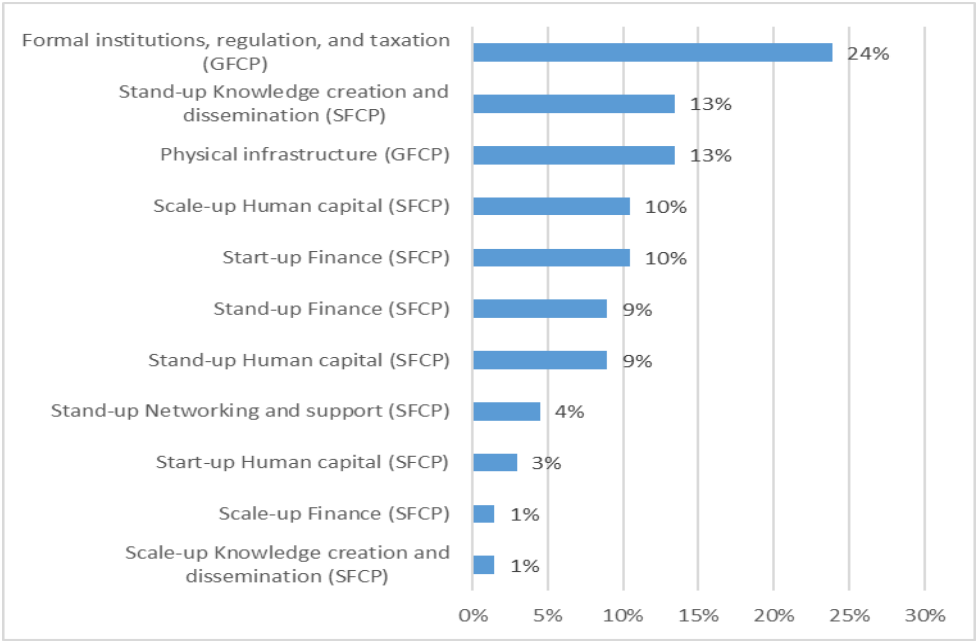


Weakest pillar	Formal institutions, regulation, taxation (44,2)
Strongest pillar	Market conditions (87,8)

Table 10. Belgium's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	59,9	82,1	75,8
	Formal institutions, regulation, taxation	44,2	69,2	60,8
	Market conditions	87,8	70,9	96,8
	Physical infrastructure	51,8	93,0	64,7
Systemic Framework Conditions	Human capital	55,0	64,8	72,3
	Knowledge creation and dissemination	56,9	66,6	68,2
	Finance	55,9	45,8	73,2
	Networking and support	64,5	72,9	79,1
EIDES SCORE		**57,8**	**70,7**	**73,8**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	58,4		
	Digital Entrepreneurship Start-up	56,1		
	Digital Entrepreneurship Scale-up	58,8		

Table 11. Belgium's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

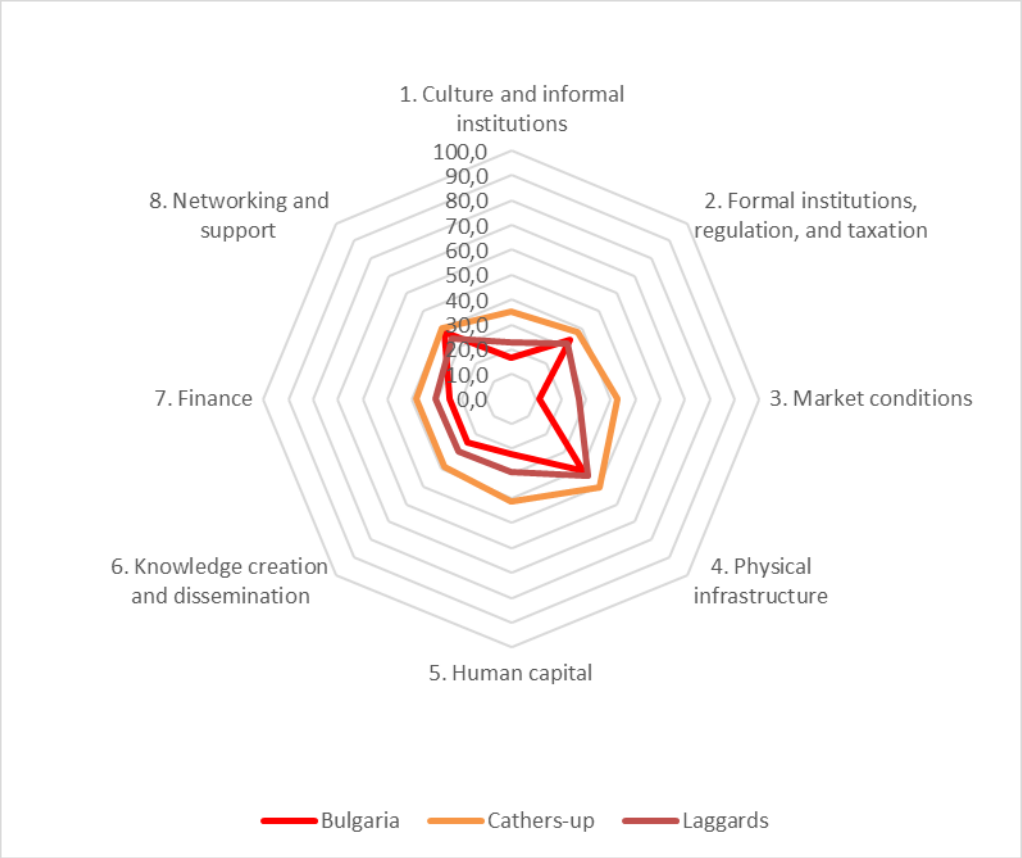


Sum of additional resources for 10% EIDES score increase (in unit per population) 67,0

6.2.3 Bulgaria

Size of population 2016-2018 (in Millions)	7,1
Per capita GDP in Euro 2015-2017 average (PPP)	14 233
Country group	Laggards
EIDES rank (score)	28 (24,9)
Digital Entrepreneurship Stand-up sub-index rank (score)	28 (23,9)
Digital Entrepreneurship Start-up sub-index rank (score)	28 (26,1)
Digital Entrepreneurship Scale-up sub-index rank (score)	27 (24,8)

Figure 7. Bulgaria's position in the eight EIDES pillars

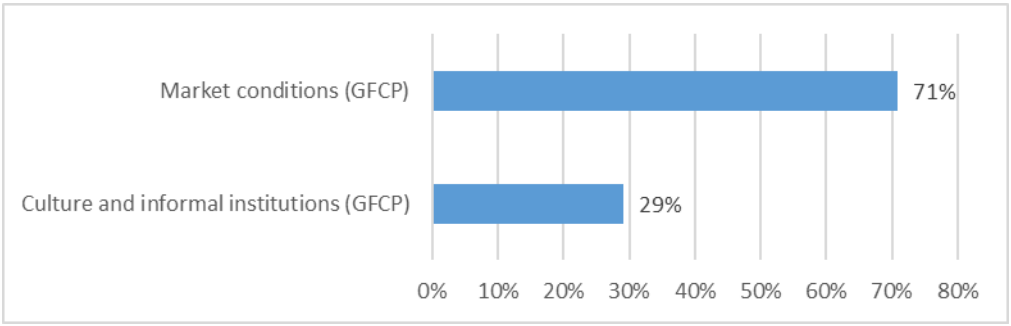


Weakest pillar	Market conditions (11,0)
Strongest pillar	Physical infrastructure (41,0)

Table 12. Bulgaria's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	16,8	62,8	33,8
	Formal institutions, regulation, taxation	33,4	60,6	53,1
	Market conditions	11,0	62,7	29,7
	Physical infrastructure	41,0	78,0	70,2
Systemic Framework Conditions	Human capital	21,9	48,4	44,3
	Knowledge creation and dissemination	24,8	39,1	51,3
	Finance	25,2	30,4	40,5
	Networking and support	38,1	60,8	59,8
EIDES SCORE		**24,9**	**55,4**	**47,8**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	23,9		
	Digital Entrepreneurship Start-up	26,1		
	Digital Entrepreneurship Scale-up	24,8		

Table 13. Bulgaria's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

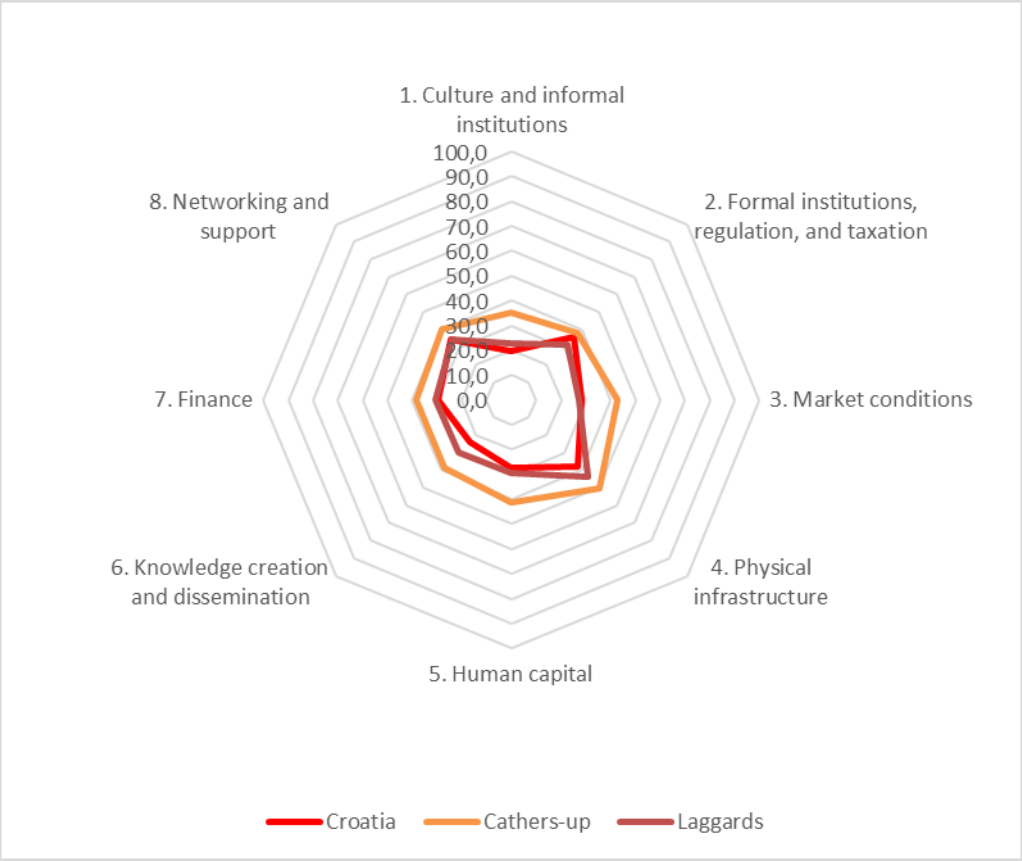


Sum of additional resources for 10% EIDES score increase (in unit per population) 14,0

6.2.4 Croatia

Size of population 2016-2018 (in Millions)	4,2
Per capita GDP in Euro 2016-2018 average (PPP)	17 900
Country group	Laggards
EIDES rank (score)	25 (28,7)
Digital Entrepreneurship Stand-up sub-index rank (score)	25 (27,2)
Digital Entrepreneurship Start-up sub-index rank (score)	25 (30,7)
Digital Entrepreneurship Scale-up sub-index rank (score)	25 (28,3)

Figure 8. Croatia's position in the eight EIDES pillars

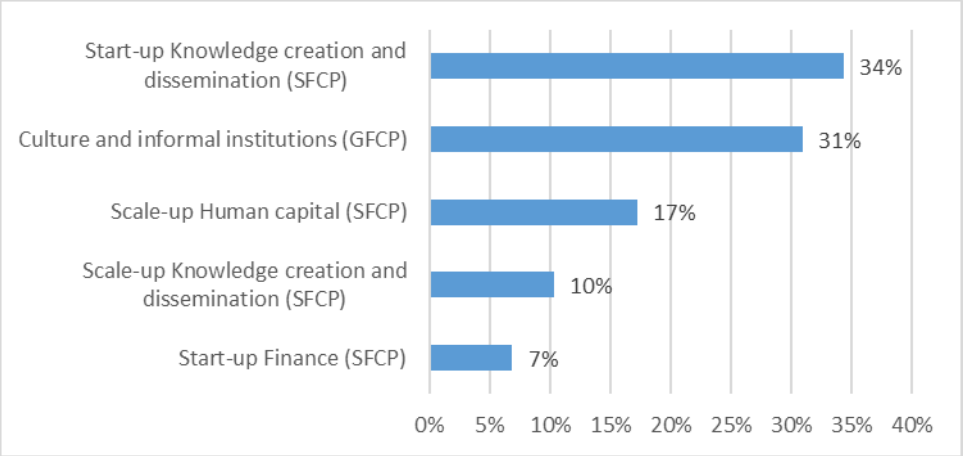


Weakest pillar	Culture, informal institutions (19,5)
Strongest pillar	Physical infrastructure (38,1)

Table 14. Croatia's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	19,5	55,5	55,0
	Formal institutions, regulation, taxation	35,8	65,3	52,4
	Market conditions	28,2	62,6	53,6
	Physical infrastructure	38,1	83,6	61,1
Systemic Framework Conditions	Human capital	27,2	47,1	53,6
	Knowledge creation and dissemination	24,0	37,9	49,6
	Finance	29,8	29,0	49,8
	Networking and support	34,6	55,2	59,8
EIDES SCORE		**28,7**	**54,5**	**54,4**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	27,2		
	Digital Entrepreneurship Start-up	30,7		
	Digital Entrepreneurship Scale-up	28,3		

Table 15. Croatia's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

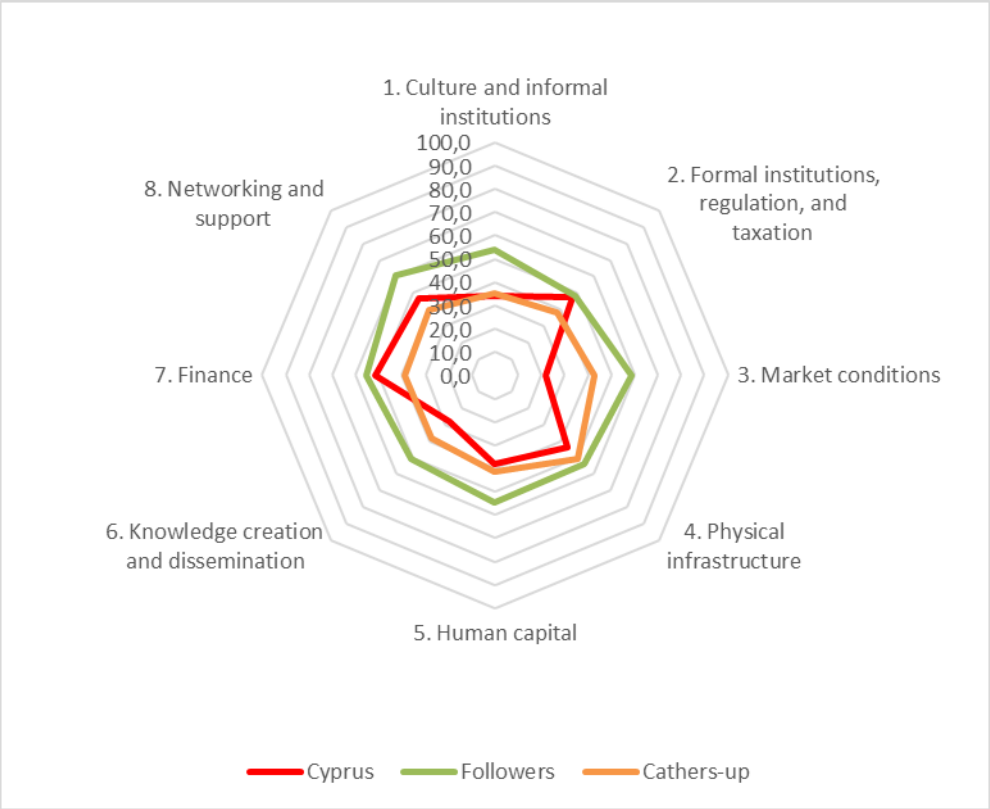


Sum of additional resources for 10% EIDES score increase (in unit per population) 29,0

6.2.5 Cyprus

Size of population 2016-2018 (in Millions)	0,90
Per capita GDP in Euro 2016-2018 average (PPP)	24 533
Country group	Catchers-up
EIDES rank (score)	19 (36,9)
Digital Entrepreneurship Stand-up sub-index rank (score)	19 (36,7)
Digital Entrepreneurship Start-up sub-index rank (score)	18 (38,6)
Digital Entrepreneurship Scale-up sub-index rank (score)	20 (35,4)

Figure 9. Cyprus's position in the eight EIDES pillars

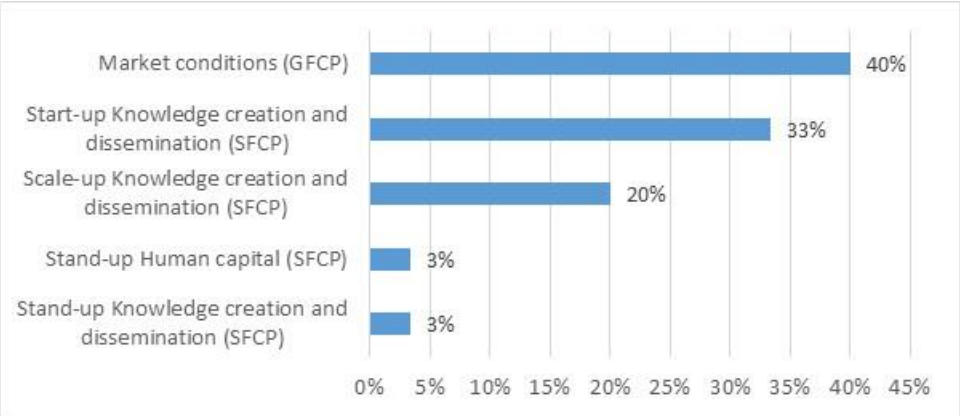


Weakest pillar	Market conditions (21,5)
Strongest pillar	Finance (51,2)

Table 16. Cyprus's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	34,0	68,9	61,1
	Formal institutions, regulation, taxation	47,4	76,0	58,9
	Market conditions	21,5	65,5	43,4
	Physical infrastructure	43,9	81,8	68,9
Systemic Framework Conditions	Human capital	37,9	60,1	57,3
	Knowledge creation and dissemination	28,0	49,4	45,1
	Finance	51,2	49,3	64,2
	Networking and support	46,3	65,1	67,0
EIDES SCORE		**36,9**	**64,5**	**58,2**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	36,7		
	Digital Entrepreneurship Start-up	38,6		
	Digital Entrepreneurship Scale-up	35,4		

Table 17. Cyprus's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

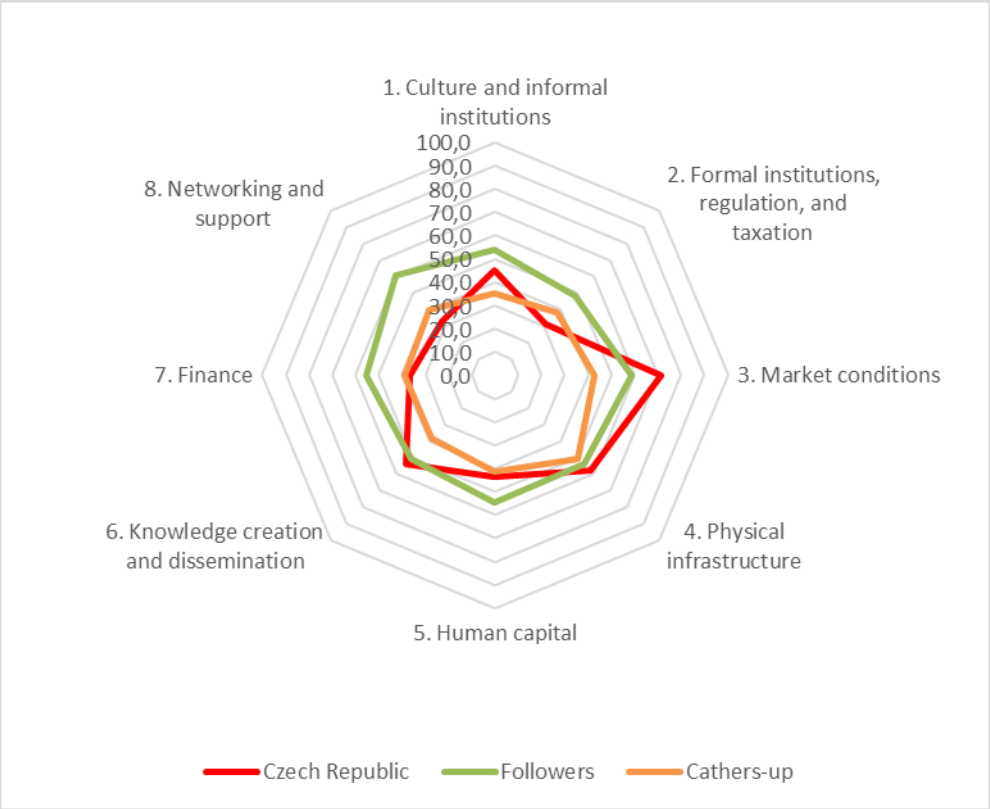


Sum of additional resources for 10% EIDES score increase (in unit per population) 30,0

6.2.6 Czech Republic

Size of population 2016-2018 (in Millions)	10,6
Per capita GDP in Euro 2016-2018 average (PPP)	25 900
Country group	Catchers-up
EIDES rank (score)	15 (43,9)
Digital Entrepreneurship Stand-up sub-index rank (score)	15 (43,6)
Digital Entrepreneurship Start-up sub-index rank (score)	15 (44,3)
Digital Entrepreneurship Scale-up sub-index rank (score)	15 (43,7)

Figure 10. Czech Republic's position in the eight EIDES pillars

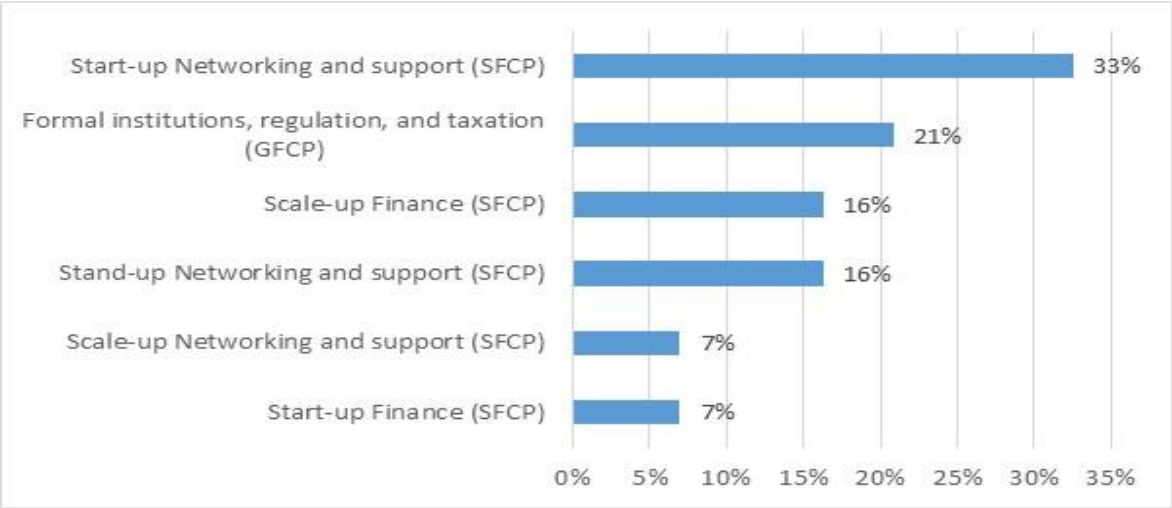


Weakest pillar	Formal institutions, regulation and taxation (30,9)
Strongest pillar	Market conditions (71,3)

Table 18. Czech Republic's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	45,0	73,5	72,0
	Formal institutions, regulation, taxation	30,9	57,4	52,1
	Market conditions	71,3	76,4	79,5
	Physical infrastructure	57,7	90,7	71,8
Systemic Framework Conditions	Human capital	43,6	58,9	65,1
	Knowledge creation and dissemination	53,8	58,0	73,6
	Finance	36,7	33,0	58,1
	Networking and support	32,5	55,7	56,8
EIDES SCORE		**43,9**	**62,9**	**66,1**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	43,6		
	Digital Entrepreneurship Start-up	44,3		
	Digital Entrepreneurship Scale-up	43,7		

Table 19. Czech Republic's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

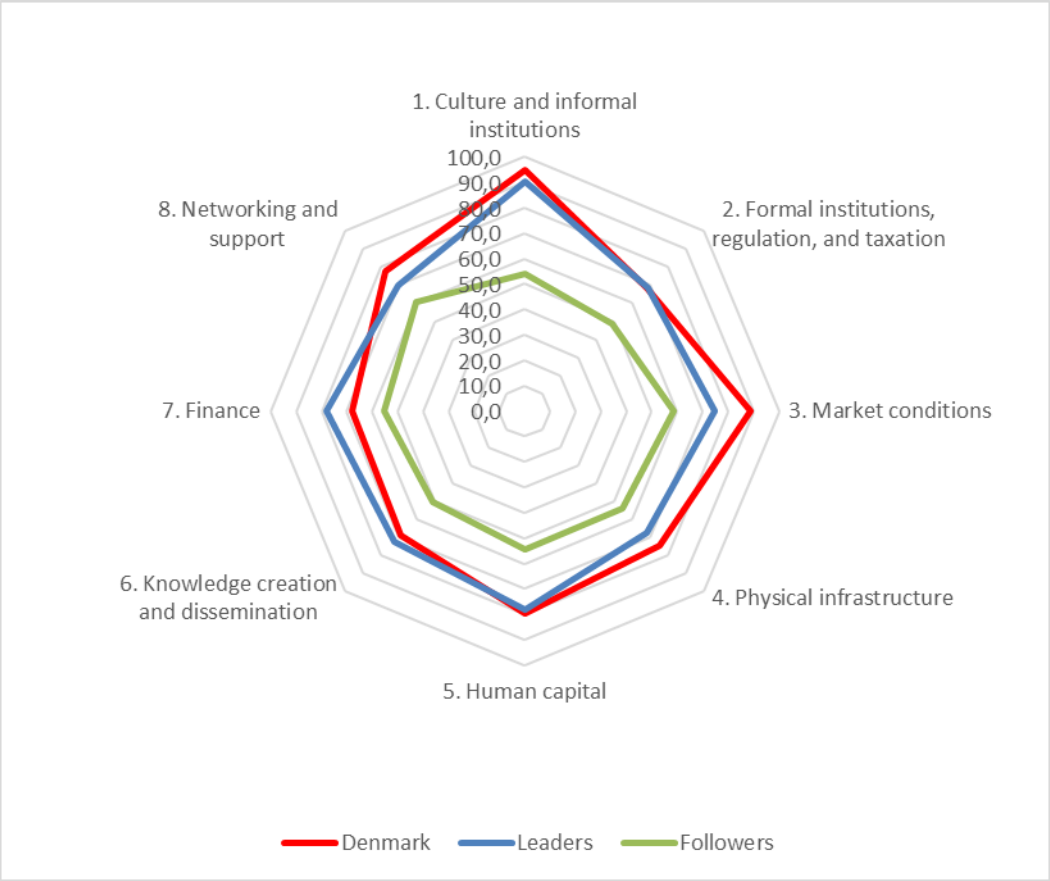


Sum of additional resources for 10% EIDES score increase (in unit per population) 43,0

6.2.7 Denmark

Size of population 2016-2018 (in Millions)	5,7
Per capita GDP in Euro 2016-2018 average (PPP)	37 400
Country group	Leaders
EIDES rank (score)	2 (75,1)
Digital Entrepreneurship Stand-up sub-index rank (score)	1 (79,1)
Digital Entrepreneurship Start-up sub-index rank (score)	3 (70,1)
Digital Entrepreneurship Scale-up sub-index rank (score)	2 (76,1)

Figure 11. Denmark's position in the eight EIDES pillars

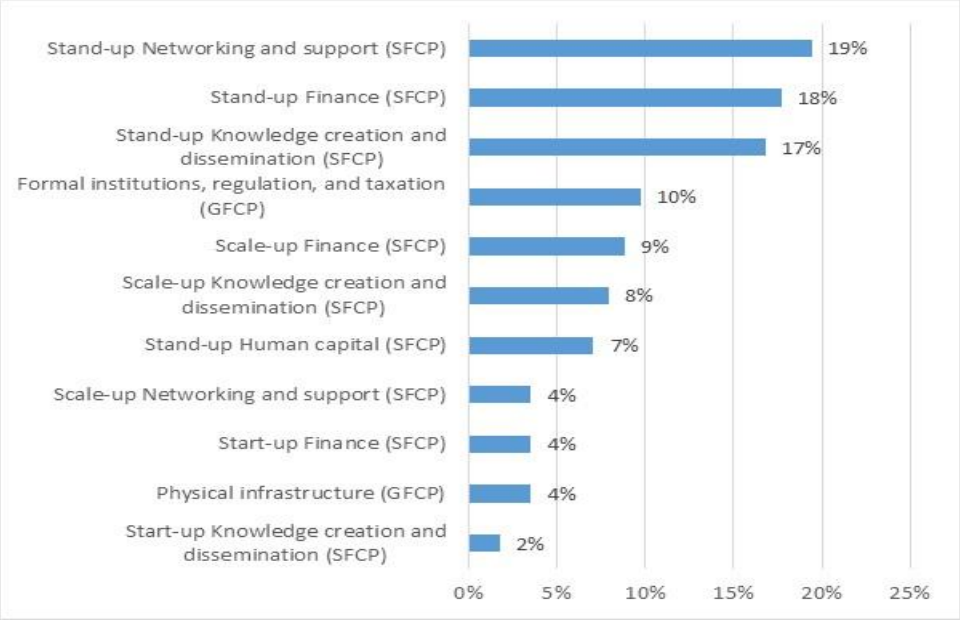


Weakest pillar	Finance (68,0)
Strongest pillar	Culture, informal institutions (94,9)

Table 20. Denmark's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	94,9	92,1	96,8
	Formal institutions, regulation, taxation	68,3	84,1	75,8
	Market conditions	88,9	71,7	96,6
	Physical infrastructure	75,0	92,6	82,6
Systemic Framework Conditions	Human capital	79,8	79,0	82,7
	Knowledge creation and dissemination	68,9	76,5	71,7
	Finance	68,0	57,8	77,8
	Networking and support	77,5	80,3	83,4
EIDES SCORE		**75,1**	**79,3**	**83,4**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	79,1		
	Digital Entrepreneurship Start-up	70,1		
	Digital Entrepreneurship Scale-up	76,1		

Table 21. Denmark's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

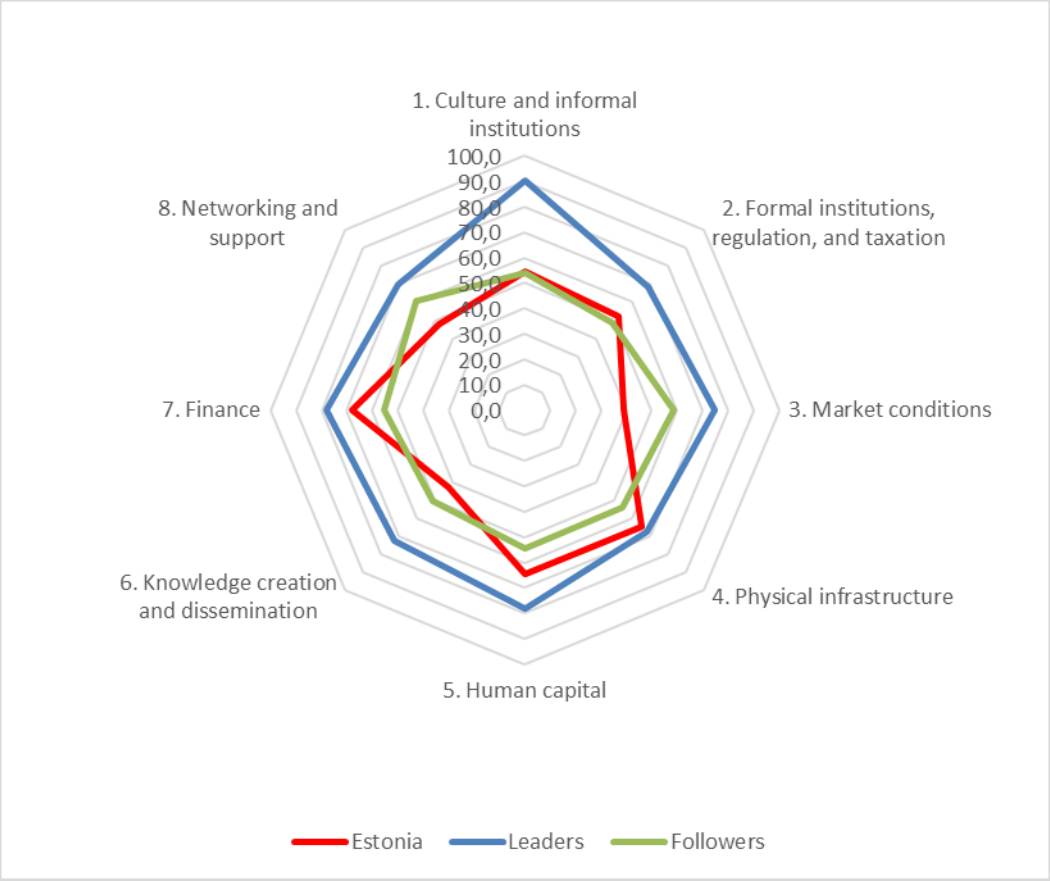


Sum of additional resources for 10% EIDES score increase (in unit per population) 113,0

6.2.8 Estonia

Size of population 2016-2018 (in Millions)	1,3
Per capita GDP in Euro 2016-2018 average (PPP)	22 700
Country group	Followers
EIDES rank (score)	11 (52,4)
Digital Entrepreneurship Stand-up sub-index rank (score)	10 (54,2)
Digital Entrepreneurship Start-up sub-index rank (score)	10 (53,3)
Digital Entrepreneurship Scale-up sub-index rank (score)	12 (49,5)

Figure 12. Estonia's position in the eight EIDES pillars

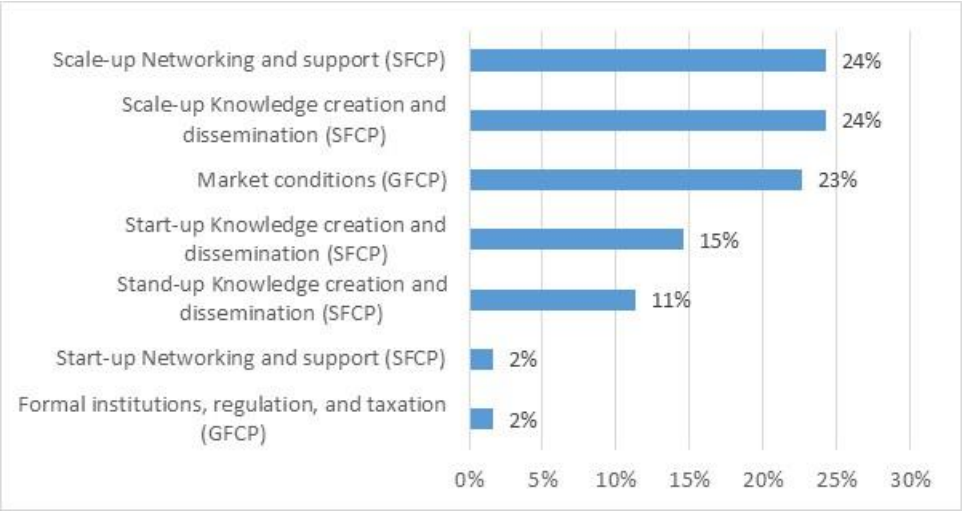


Weakest pillar	Market conditions (38,8)
Strongest pillar	Finance (68,2)

Table 22. Estonia's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Frame-work Conditions	Culture, informal institutions	54,3	78,7	75,2
	Formal institutions, regulation, taxation	52,2	73,2	67,4
	Market conditions	38,8	65,7	62,5
	Physical infrastructure	64,9	81,6	88,9
Systemic Frame-work Conditions	Human capital	64,3	61,4	85,7
	Knowledge creation and dissemination	42,5	54,5	61,8
	Finance	68,2	43,0	93,4
	Networking and support	47,9	75,0	60,4
EIDES SCORE		**52,4**	**66,6**	**74,4**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	54,2		
	Digital Entrepreneurship Start-up	53,3		
	Digital Entrepreneurship Scale-up	49,5		

Table 23. Estonia's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

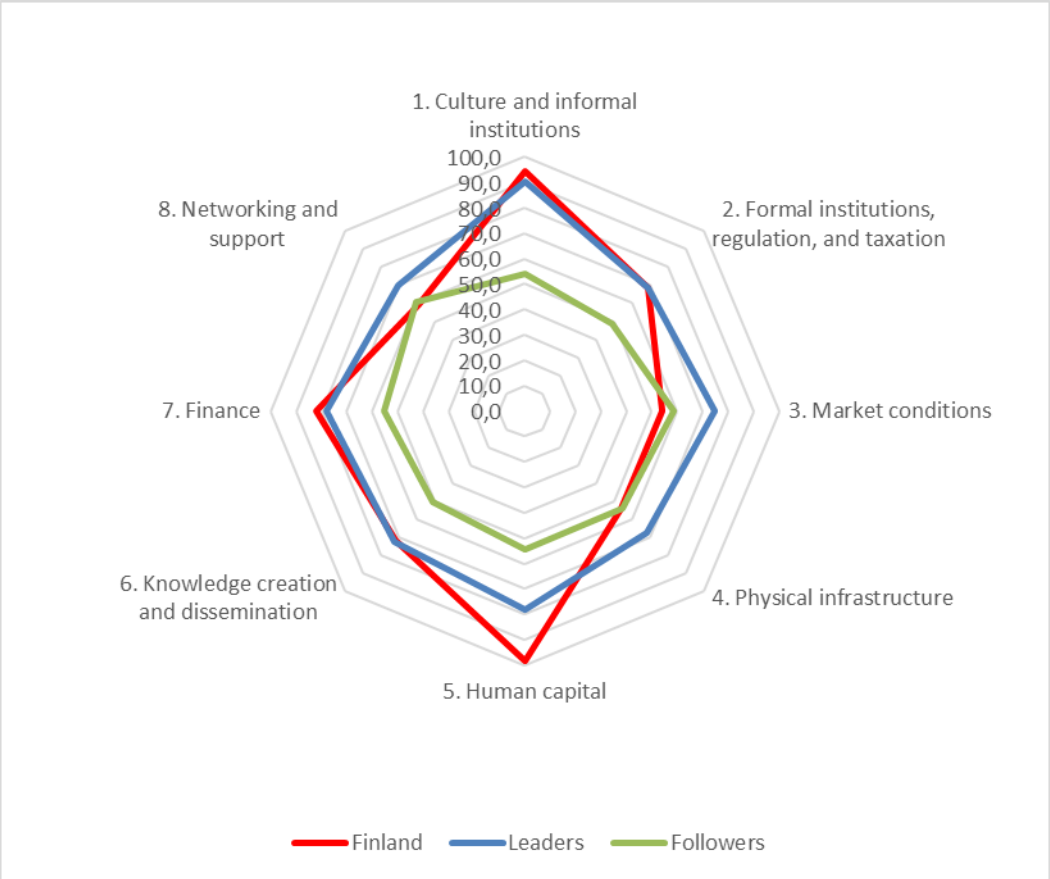


Sum of additional resources for 10% EIDES score increase (in unit per population) 62,0

6.2.9 Finland

Size of population 2016-2018 (in Millions)	5,5
Per capita GDP in Euro 2016-2018 average (PPP)	32 067
Country group	Leaders
EIDES rank (score)	5 (69,5)
Digital Entrepreneurship Stand-up sub-index rank (score)	5 (71,4)
Digital Entrepreneurship Start-up sub-index rank (score)	4 (67,8)
Digital Entrepreneurship Scale-up sub-index rank (score)	5 (69,2)

Figure 13. Finland's position in the eight EIDES pillars

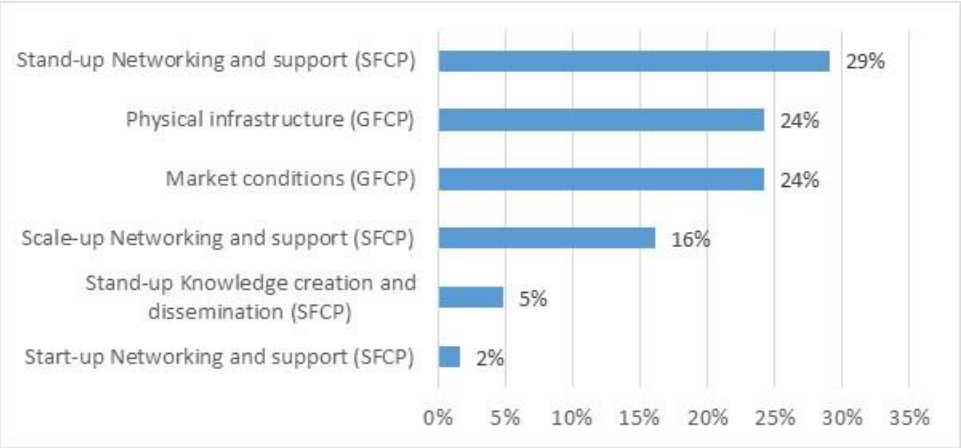


Weakest pillar	Physical infrastructure (53,8)
Strongest pillar	Human capital (98,3)

Table 24. Finland's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Frame-work Conditions	Culture, informal institutions	94,6	92,7	94,9
	Formal institutions, regulation, taxation	68,8	85,4	75,2
	Market conditions	54,3	65,4	77,3
	Physical infrastructure	53,8	88,0	71,4
Systemic Frame-work Conditions	Human capital	98,3	80,5	96,0
	Knowledge creation and dissemination	71,9	79,9	72,7
	Finance	81,9	58,2	94,4
	Networking and support	59,3	79,3	68,4
EIDES SCORE		**69,5**	**78,7**	**81,3**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	71,4		
	Digital Entrepreneurship Start-up	67,8		
	Digital Entrepreneurship Scale-up	69,2		

Table 25. Finland's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

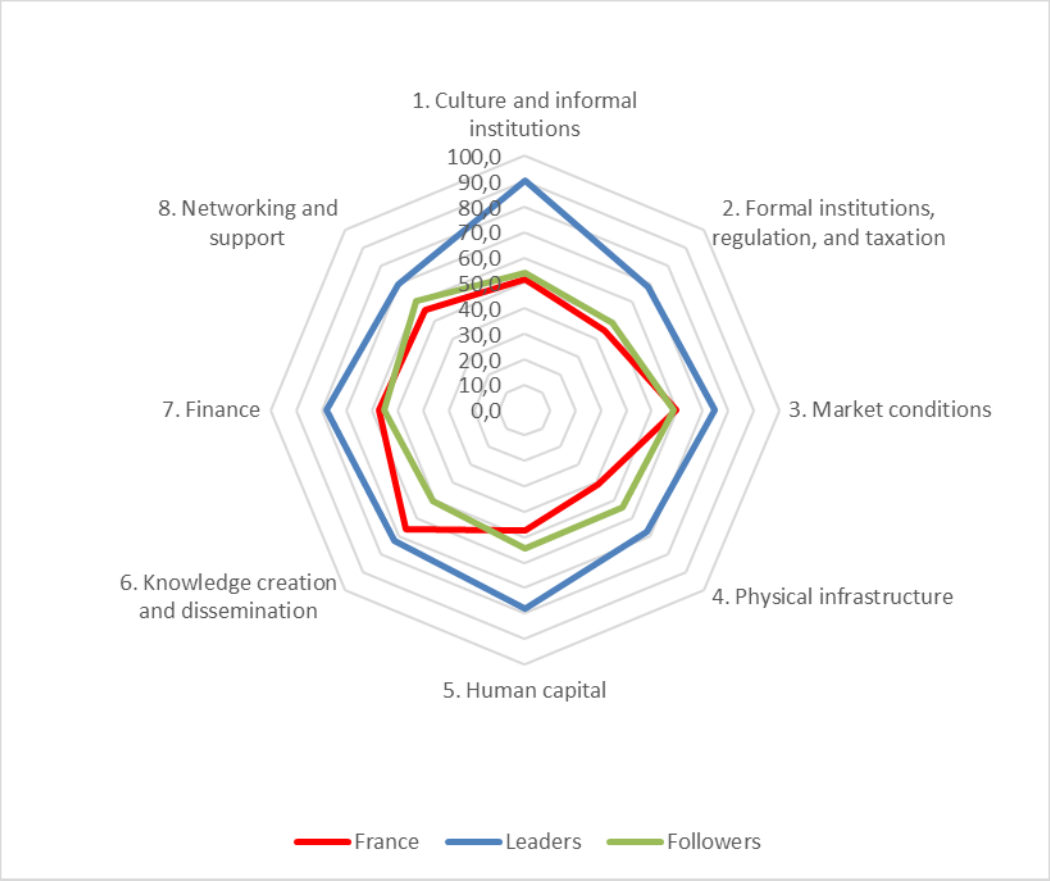


Sum of additional resources for 10% EIDES score increase (in unit per population) 62,0

6.2.10 France

Size of population 2016-2018 (in Millions)	66,8
Per capita GDP in Euro 2016-2018 average (PPP)	30 767
Country group	Followers
EIDES rank (score)	12 (51,8)
Digital Entrepreneurship Stand-up sub-index rank (score)	12 (50,4)
Digital Entrepreneurship Start-up sub-index rank (score)	12 (52,6)
Digital Entrepreneurship Scale-up sub-index rank (score)	11 (52,5)

Figure 14. France's position in the eight EIDES pillars

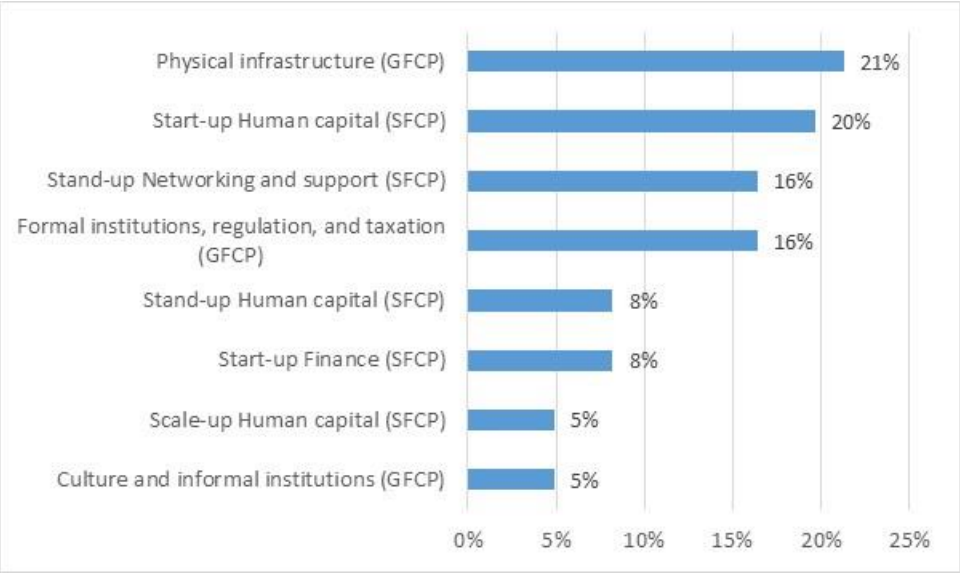


Weakest pillar	Physical infrastructure (41,2)
Strongest pillar	Knowledge creation and dissemination (66,0)

Table 26. France's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	51,4	80,1	67,6
	Formal institutions, regulation, taxation	44,2	70,7	59,3
	Market conditions	59,9	67,0	80,3
	Physical infrastructure	41,2	96,7	53,1
Systemic Framework Conditions	Human capital	47,3	65,4	63,8
	Knowledge creation and dissemination	66,0	72,9	73,2
	Finance	57,5	55,9	67,5
	Networking and support	55,7	69,8	72,2
EIDES SCORE		**51,8**	**72,3**	**67,1**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	50,4		
	Digital Entrepreneurship Start-up	52,6		
	Digital Entrepreneurship Scale-up	52,5		

Table 27. France's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

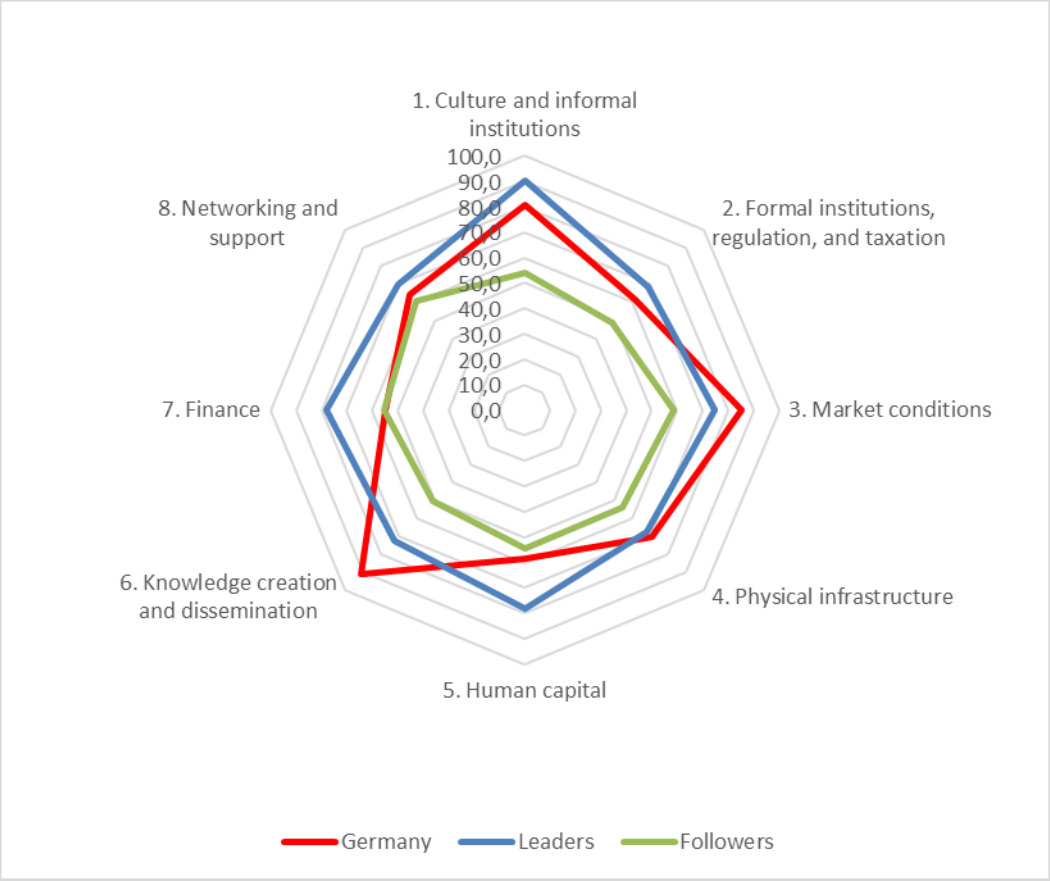


Sum of additional resources for 10% EIDES score increase (in unit per population) 61,0

6.2.11 Germany

Size of population 2016-2018 (in Millions)	82,5
Per capita GDP in Euro 2016-2018 average (PPP)	36 500
Country group	Leaders
EIDES rank (score)	6 (67,8)
Digital Entrepreneurship Stand-up sub-index rank (score)	7 (67,9)
Digital Entrepreneurship Start-up sub-index rank (score)	6 (66,7)
Digital Entrepreneurship Scale-up sub-index rank (score)	6 (68,6)

Figure 15. Germany's position in the eight EIDES pillars



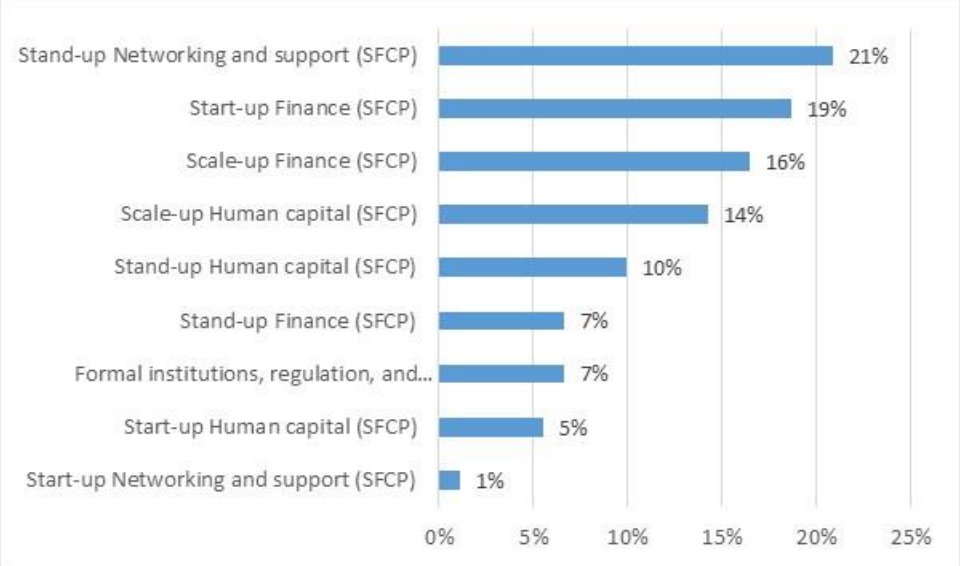
Weakest pillar	Human capital (58,7)
Strongest pillar	Knowledge creation and dissemination (91,1)

Table 28. Germany's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	81,0	88,9	88,0
	Formal institutions, regulation, taxation	61,6	79,0	73,2
	Market conditions	85,3	77,9	87,2
	Physical infrastructure	70,5	99,2	72,6
Systemic Framework Conditions	Human capital	58,7	66,3	74,6
	Knowledge creation and dissemination	91,1	81,3	91,1
	Finance	54,8	56,4	63,6
	Networking and support	64,1	72,2	79,1
EIDES SCORE		**67,8**	**77,7**	**78,7**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	67,9		
	Digital Entrepreneurship Start-up	66,7		
	Digital Entrepreneurship Scale-up	68,6		

Table 29. Germany's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

Sum of additional resources for 10% EIDES score increase (in unit per population) 67,9

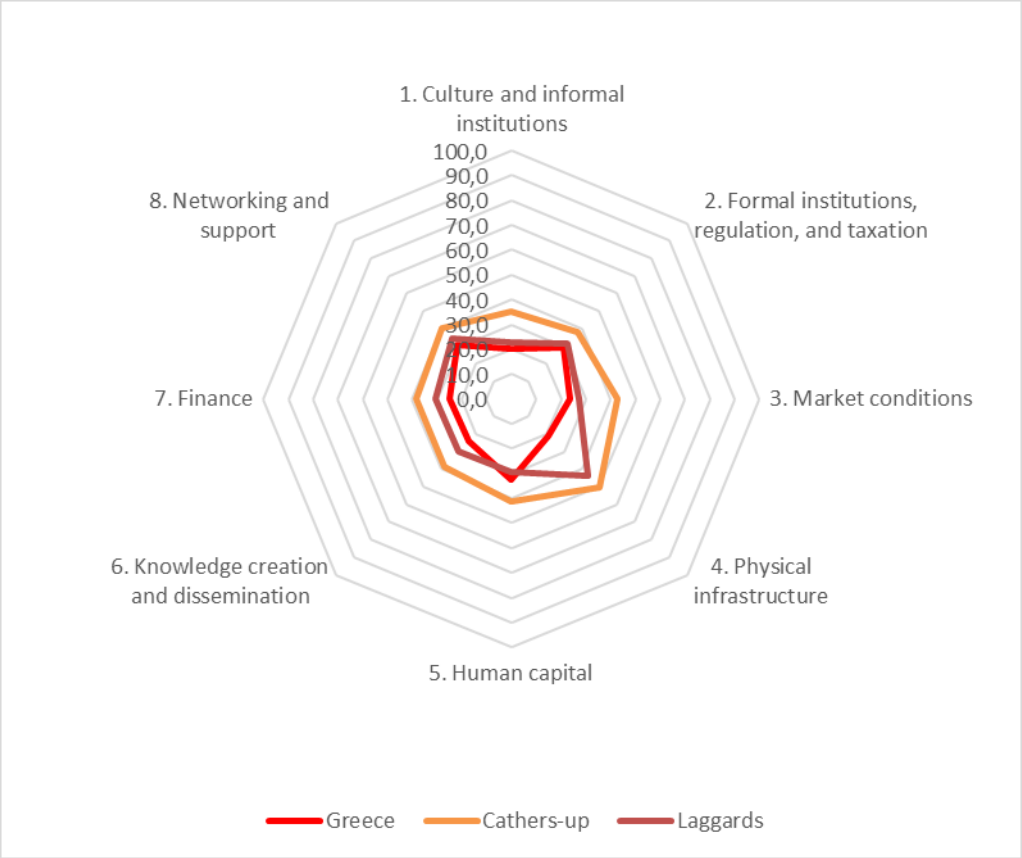


Sum of additional resources for 10% EIDES score increase (in unit per population) 91,0

6.2.12 Greece

Size of population 2016-2018 (in Millions)	10,8
Per capita GDP in Euro 2016-2018 average (PPP)	20 067
Country group	Laggards
EIDES rank (score)	27 (25,5)
Digital Entrepreneurship Stand-up sub-index rank (score)	27 (24,8)
Digital Entrepreneurship Start-up sub-index rank (score)	27 (27,3)
Digital Entrepreneurship Scale-up sub-index rank (score)	28 (24,5)

Figure 16. Greece's position in the eight EIDES pillars

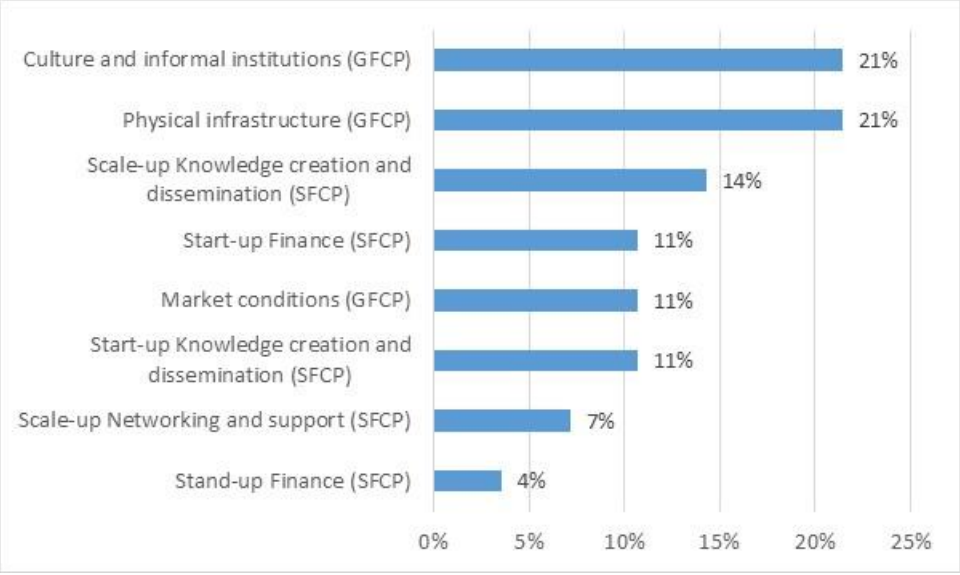


Weakest pillar	Culture, informal institutions (20,2)
Strongest pillar	Human capital (32,5)

Table 30. Greece's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	20,2	60,5	46,3
	Formal institutions, regulation, taxation	29,5	51,0	56,5
	Market conditions	23,5	70,8	42,7
	Physical infrastructure	20,7	82,7	41,9
Systemic Framework Conditions	Human capital	32,5	60,7	49,9
	Knowledge creation and dissemination	24,3	43,4	45,0
	Finance	24,9	25,5	45,4
	Networking and support	30,6	58,2	51,3
EIDES SCORE		**25,5**	**56,6**	**47,4**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	24,8		
	Digital Entrepreneurship Start-up	27,3		
	Digital Entrepreneurship Scale-up	24,5		

Table 31. Greece's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

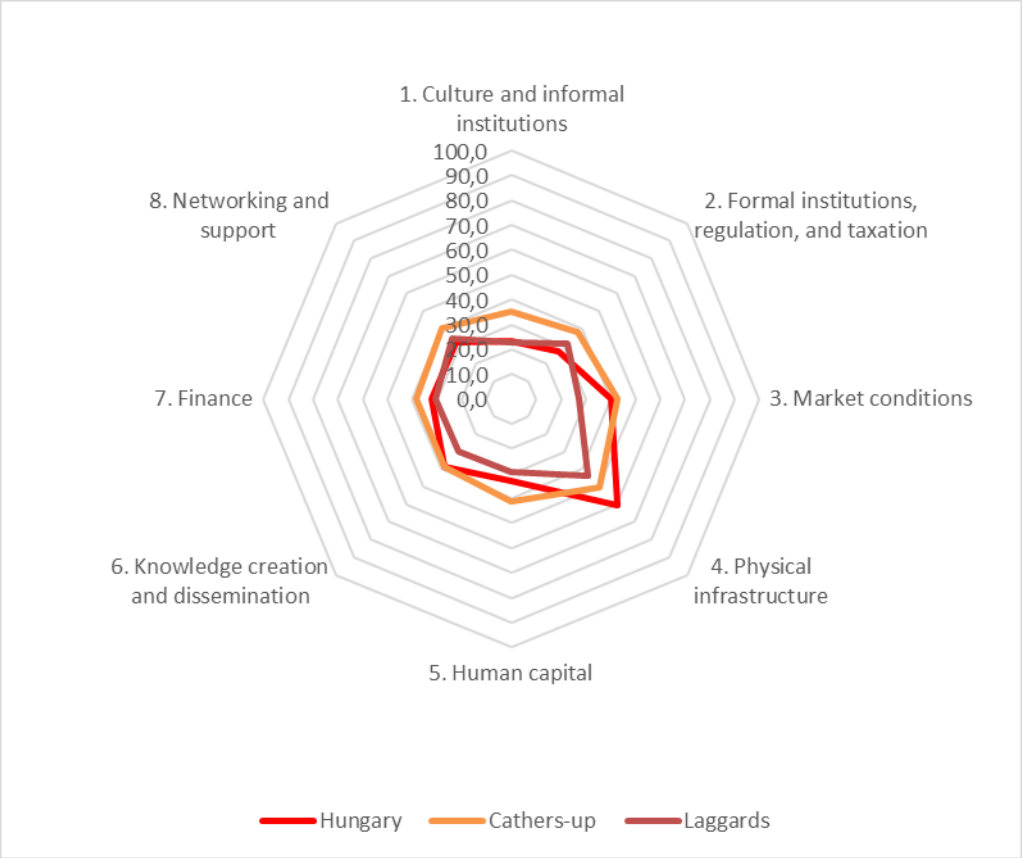


Sum of additional resources for 10% EIDES score increase (in unit per population) 28,0

6.2.13 Hungary

Size of population 2016-2018 (in Millions)	9,8
Per capita GDP in Euro 2016-2018 average (PPP)	19 867
Country group	Laggards
EIDES rank (score)	22 (34,0)
Digital Entrepreneurship Stand-up sub-index rank (score)	23 (31,5)
Digital Entrepreneurship Start-up sub-index rank (score)	21 (35,7)
Digital Entrepreneurship Scale-up sub-index rank (score)	21 (34,8)

Figure 17. Hungary's position in the eight EIDES pillars

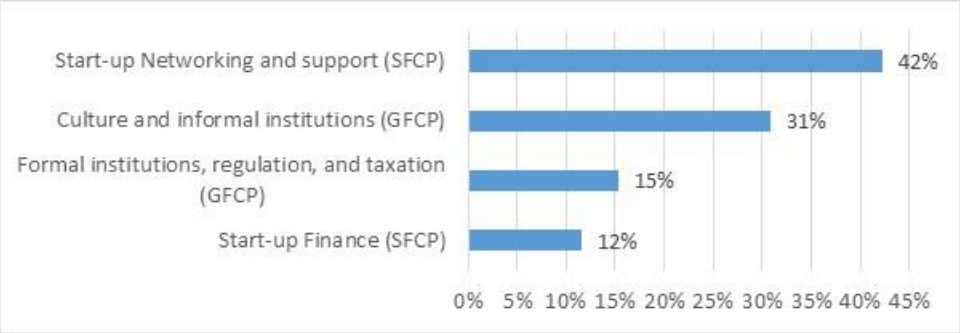


Weakest pillar	Culture, informal institutions (23,2)
Strongest pillar	Physical infrastructure (38,3)

Table 32. Hungary's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	23,2	60,0	55,4
	Formal institutions, regulation, taxation	27,0	51,2	51,5
	Market conditions	40,4	72,0	58,9
	Physical infrastructure	60,7	85,7	79,8
Systemic Framework Conditions	Human capital	33,0	49,9	60,1
	Knowledge creation and dissemination	38,3	49,1	62,1
	Finance	32,1	31,3	51,6
	Networking and support	32,0	51,0	60,1
EIDES SCORE		**34,0**	**56,3**	**59,9**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	31,5		
	Digital Entrepreneurship Start-up	35,7		
	Digital Entrepreneurship Scale-up	34,8		

Table 33. Hungary's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

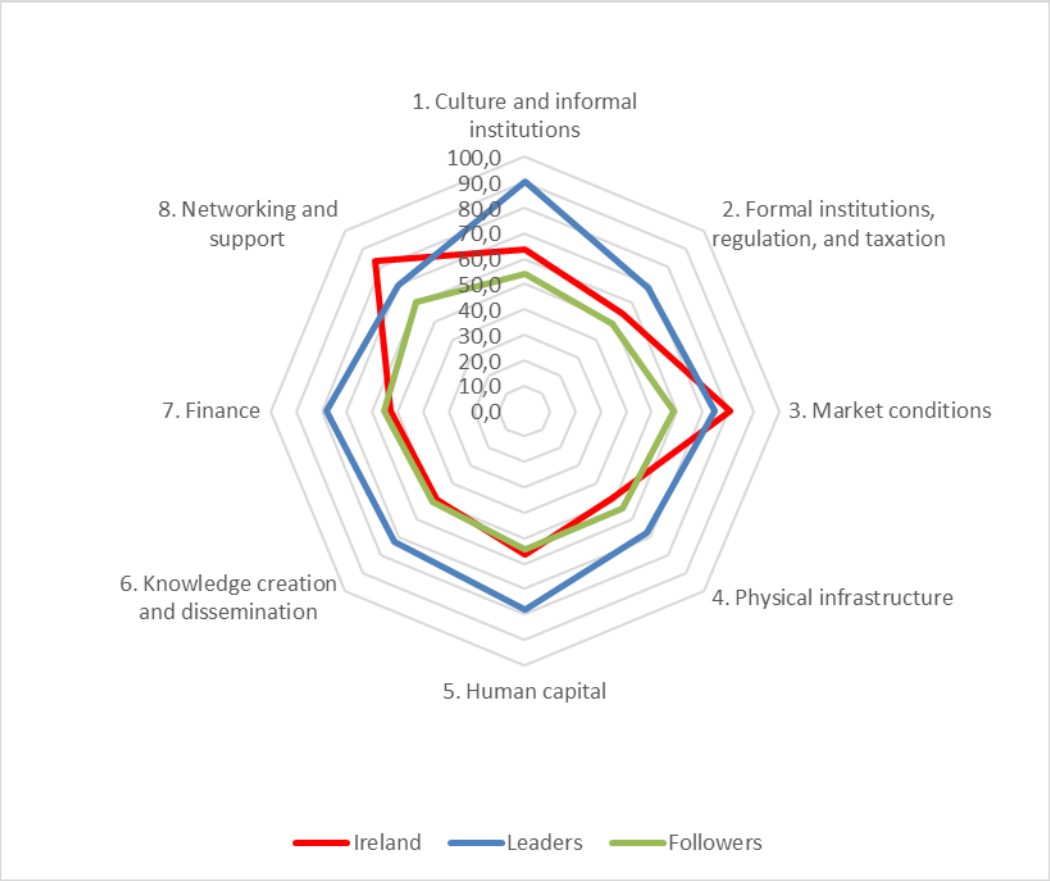


Sum of additional resources for 10% EIDES score increase (in unit per population) 26,0

6.2.14 Ireland

Size of population 2016-2018 (in Millions)	4,8
Per capita GDP in Euro 2016-2018 average (PPP)	52 633
Country group	Followers
EIDES rank (score)	8 (59,1)
Digital Entrepreneurship Stand-up sub-index rank (score)	8 (58,7)
Digital Entrepreneurship Start-up sub-index rank (score)	8 (60,2)
Digital Entrepreneurship Scale-up sub-index rank (score)	9 (58,3)

Figure 18. Ireland's position in the eight EIDES pillars

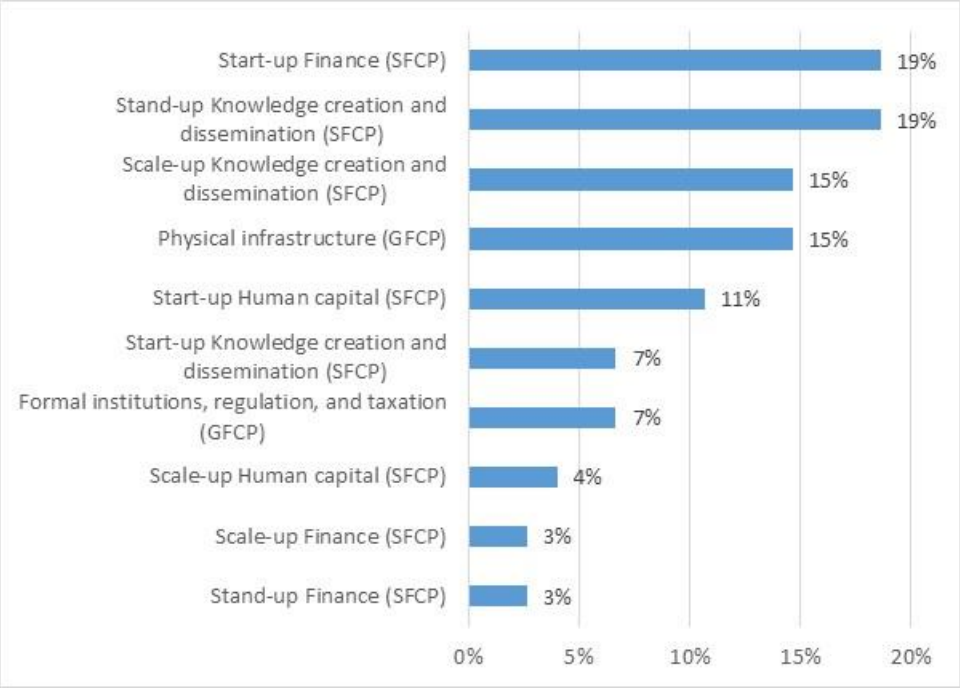


Weakest pillar	Physical infrastructure (48,6)
Strongest pillar	Networking and support (83,3)

Table 34. Ireland's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	63,7	87,3	69,8
	Formal institutions, regulation, taxation	54,2	82,7	61,4
	Market conditions	80,6	64,8	99,6
	Physical infrastructure	48,6	83,9	71,2
Systemic Framework Conditions	Human capital	56,3	70,2	68,9
	Knowledge creation and dissemination	49,1	63,4	61,6
	Finance	53,0	41,1	74,4
	Networking and support	83,3	89,7	83,0
EIDES SCORE		**59,1**	**72,9**	**73,7**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	58,7		
	Digital Entrepreneurship Start-up	60,2		
	Digital Entrepreneurship Scale-up	58,3		

Table 35. Ireland's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

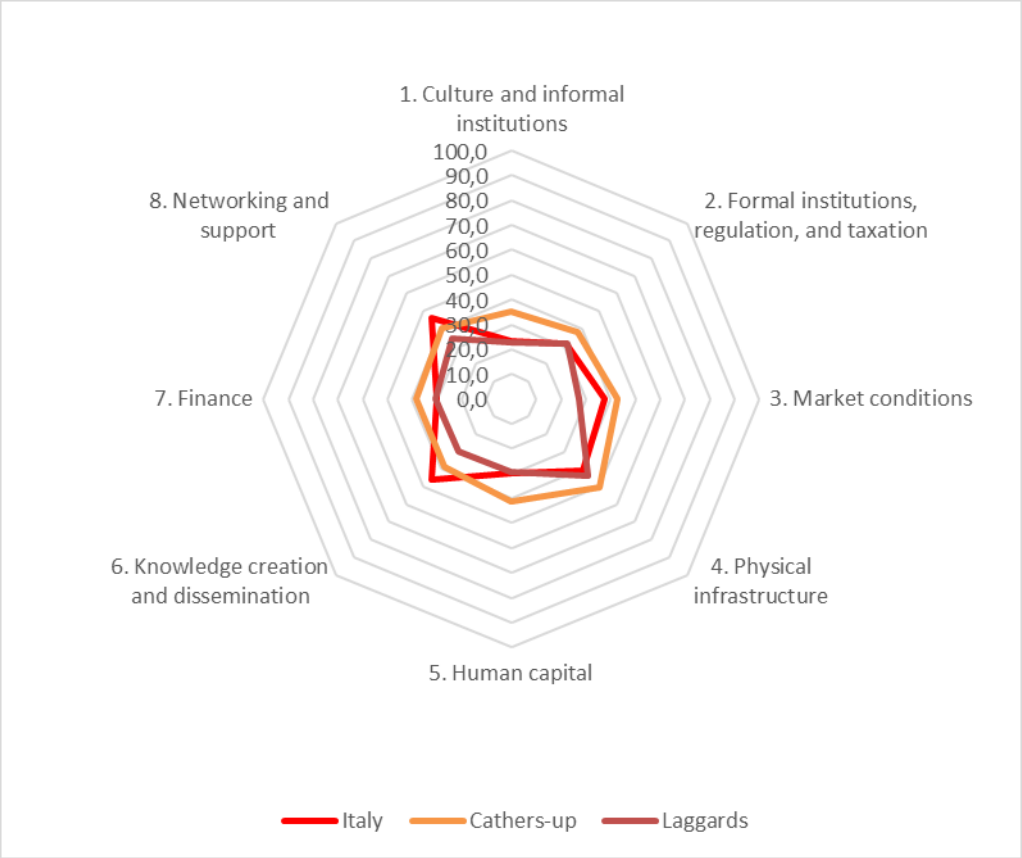


Sum of additional resources for 10% EIDES score increase (in unit per population) 75,0

6.2.15 Italy

Size of population 2016-2018 (in Millions)	60,6
Per capita GDP in Euro 2016-2018 average (PPP)	28 333
Country group	Laggards
EIDES rank (score)	22 (32,6)
Digital Entrepreneurship Stand-up sub-index rank (score)	21 (32,0)
Digital Entrepreneurship Start-up sub-index rank (score)	24 (31,8)
Digital Entrepreneurship Scale-up sub-index rank (score)	19 (34,0)

Figure 19. Italy's position in the eight EIDES pillars

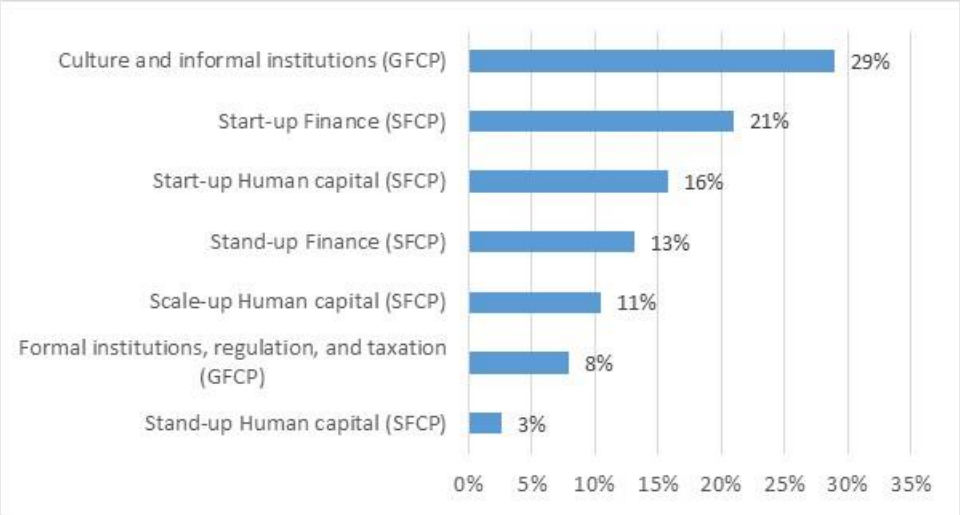


Weakest pillar	Culture, informal institutions (23,4)
Strongest pillar	Networking and support (45,8)

Table 36. Italy's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	23,4	60,8	54,1
	Formal institutions, regulation, taxation	31,3	56,9	53,3
	Market conditions	37,7	72,2	56,3
	Physical infrastructure	40,8	90,9	57,2
Systemic Framework Conditions	Human capital	30,0	56,6	49,9
	Knowledge creation and dissemination	45,7	54,0	67,3
	Finance	29,9	31,3	47,7
	Networking and support	45,8	73,9	59,1
EIDES SCORE		**34,6**	**62,1**	**55,6**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	33,3		
	Digital Entrepreneurship Start-up	35,6		
	Digital Entrepreneurship Scale-up	34,8		

Table 37. Italy's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

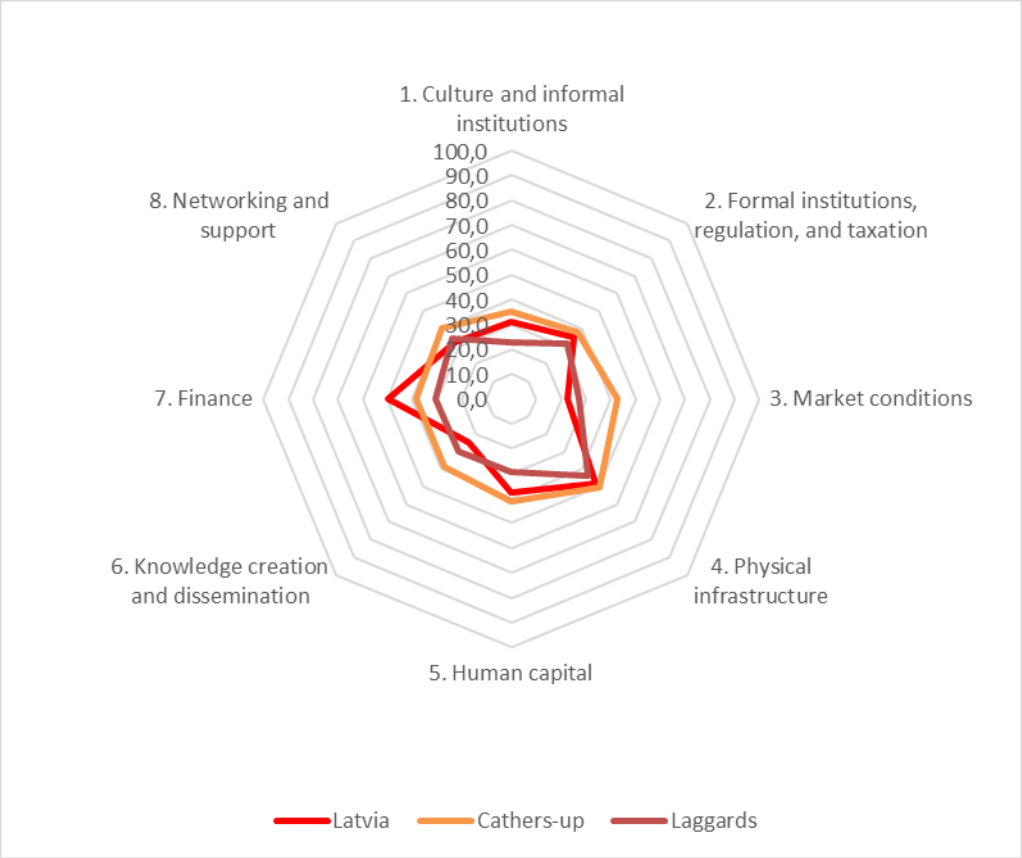


Sum of additional resources for 10% EIDES score increase (in unit per population) 38,0

6.2.16 Latvia

Size of population 2016-2018 (in Millions)	2,0
Per capita GDP in Euro 2016-2018 average (PPP)	19 133
Country group	Laggards
EIDES rank (score)	23 (33,8)
Digital Entrepreneurship Stand-up sub-index rank (score)	22 (32,4)
Digital Entrepreneurship Start-up sub-index rank (score)	23 (35,0)
Digital Entrepreneurship Scale-up sub-index rank (score)	23 (34,0)

Figure 20. Latvia's position in the eight EIDES pillars

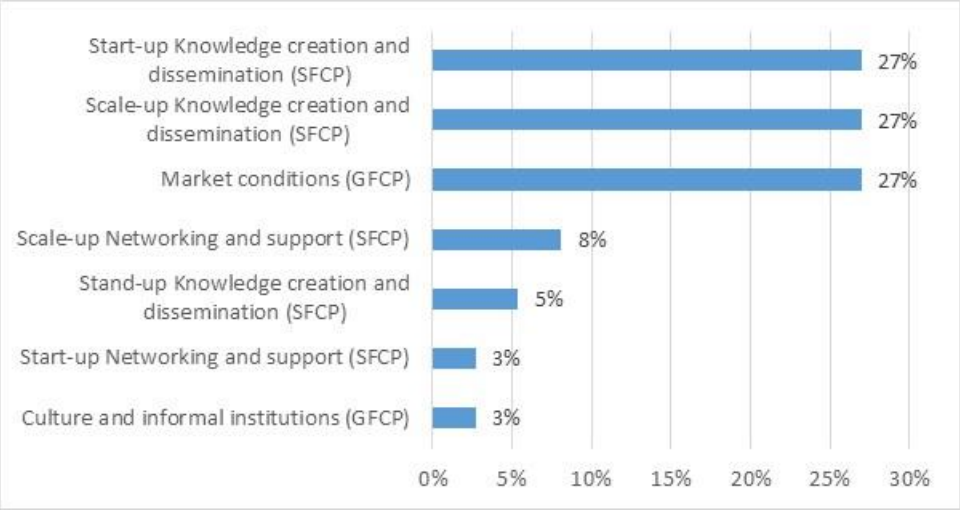


Weakest pillar	Market conditions (22,3)
Strongest pillar	Finance (49,5)

Table 38. Latvia's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	31,0	68,4	55,9
	Formal institutions, regulation, taxation	35,2	61,8	54,7
	Market conditions	22,3	65,9	44,2
	Physical infrastructure	48,0	81,3	73,5
Systemic Framework Conditions	Human capital	37,4	59,6	56,9
	Knowledge creation and dissemination	24,7	44,7	44,2
	Finance	49,5	37,2	73,3
	Networking and support	32,2	57,1	54,8
EIDES SCORE		**33,8**	**59,5**	**57,2**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	32,4		
	Digital Entrepreneurship Start-up	35,0		
	Digital Entrepreneurship Scale-up	34,0		

Table 39. Latvia's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

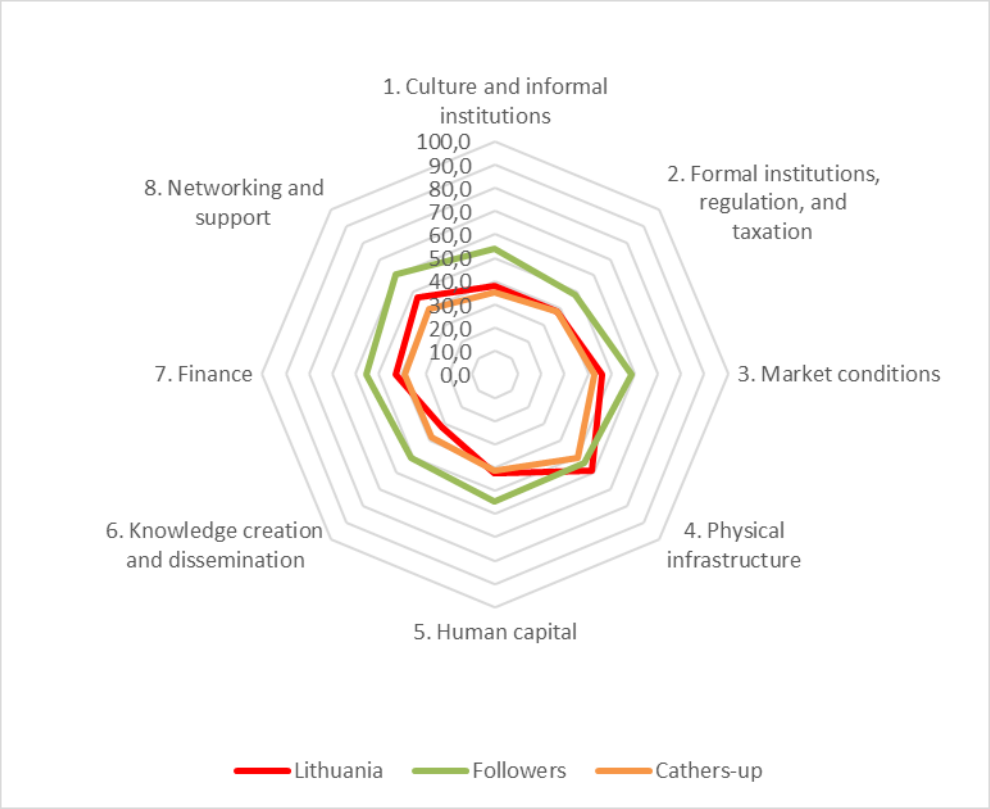


Sum of additional resources for 10% EIDES score increase (in unit per population) 37,0

6.2.17 Lithuania

Size of population 2016-2018 (in Millions)	2,8
Per capita GDP in Euro 2016-2018 average (PPP)	22 400
Country group	Catchers-up
EIDES rank (score)	16 (42,2)
Digital Entrepreneurship Stand-up sub-index rank (score)	16 (42,3)
Digital Entrepreneurship Start-up sub-index rank (score)	16 (42,7)
Digital Entrepreneurship Scale-up sub-index rank (score)	16 (41,5)

Figure 21. Lithuania's position in the eight EIDES pillars

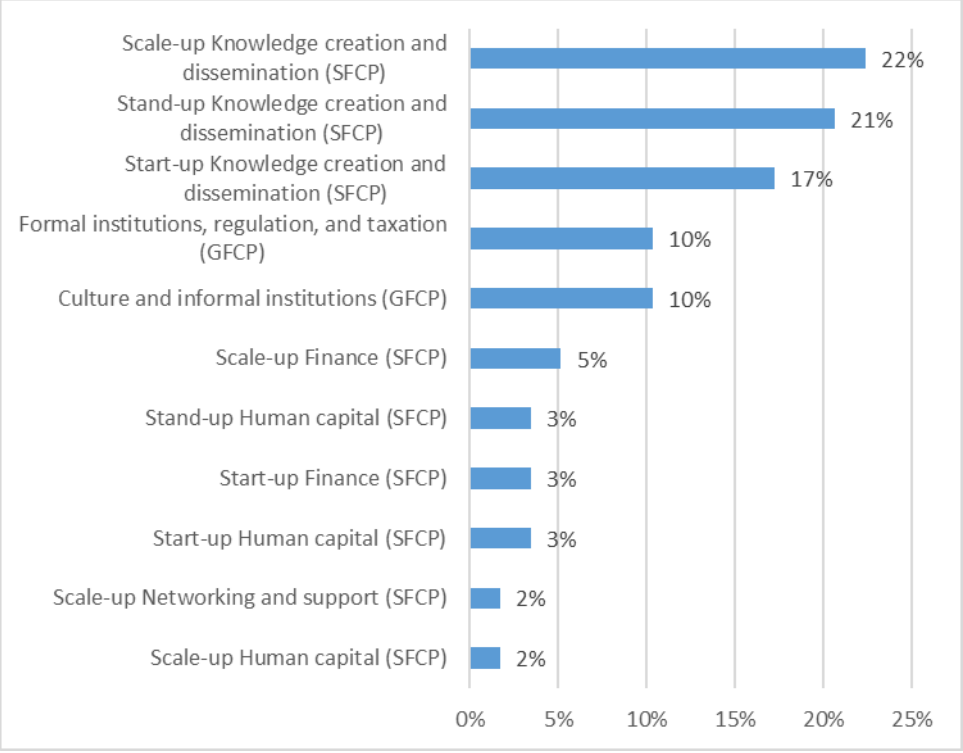


Weakest pillar	Knowledge creation and dissemination (32,4)
Strongest pillar	Physical infrastructure (58,5)

Table 40. Lithuania's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	38,1	74,4	57,4
	Formal institutions, regulation, taxation	37,9	62,5	58,1
	Market conditions	46,1	70,2	65,4
	Physical infrastructure	58,5	81,8	82,8
Systemic Framework Conditions	Human capital	42,4	59,3	63,3
	Knowledge creation and dissemination	32,4	44,4	58,3
	Finance	42,7	25,4	78,8
	Networking and support	47,0	63,3	68,6
EIDES SCORE		**42,2**	**60,2**	**66,6**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	42,3		
	Digital Entrepreneurship Start-up	42,7		
	Digital Entrepreneurship Scale-up	41,5		

Table 41. Lithuania's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

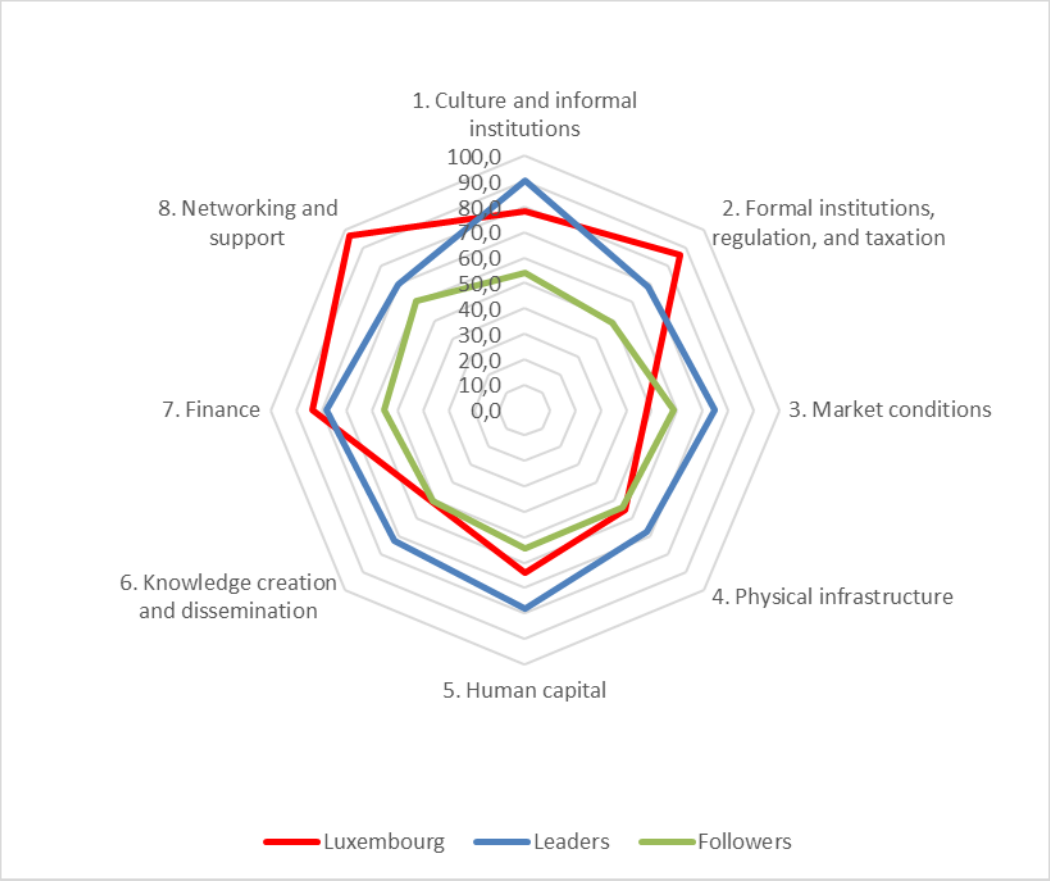


Sum of additional resources for 10% EIDES score increase (in unit per population) 58,0

6.2.18 Luxembourg

Size of population 2016-2018 (in Millions)	0,6
Per capita GDP in Euro 2016-2018 average (PPP)	76 467
Country group	Leaders
EIDES rank (score)	7 (66,8)
Digital Entrepreneurship Stand-up sub-index rank (score)	6 (68,1)
Digital Entrepreneurship Start-up sub-index rank (score)	7 (65,4)
Digital Entrepreneurship Scale-up sub-index rank (score)	7 (67,0)

Figure 22. Luxembourg's position in the eight EIDES pillars

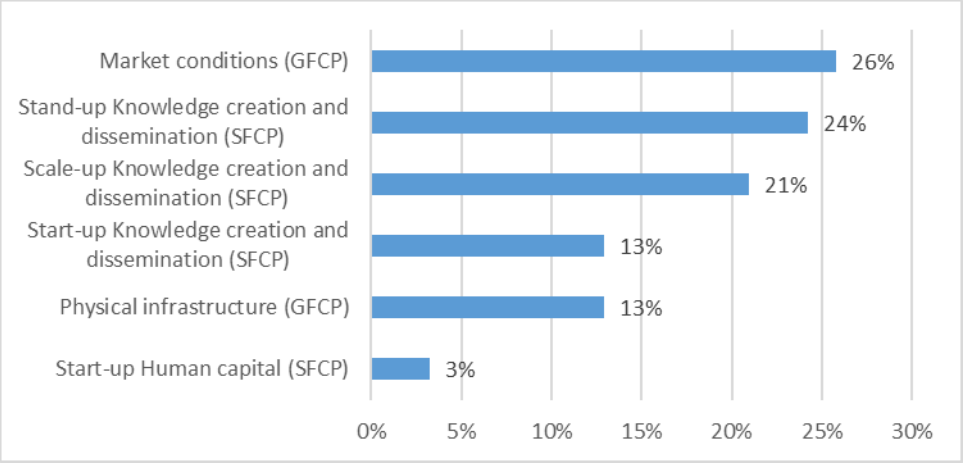


Weakest pillar	Market conditions (47,8)
Strongest pillar	Networking and support (97,4)

Table 42. Luxembourg's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	78,0	87,0	89,1
	Formal institutions, regulation, taxation	86,2	93,0	85,7
	Market conditions	47,8	68,1	68,8
	Physical infrastructure	55,6	90,9	69,8
Systemic Framework Conditions	Human capital	63,7	63,8	82,7
	Knowledge creation and dissemination	51,1	67,8	60,0
	Finance	83,7	55,7	98,9
	Networking and support	97,4	84,8	99,1
EIDES SCORE		**66,8**	**76,4**	**81,8**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	68,1		
	Digital Entrepreneurship Start-up	65,4		
	Digital Entrepreneurship Scale-up	67,0		

Table 43. Luxembourg's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

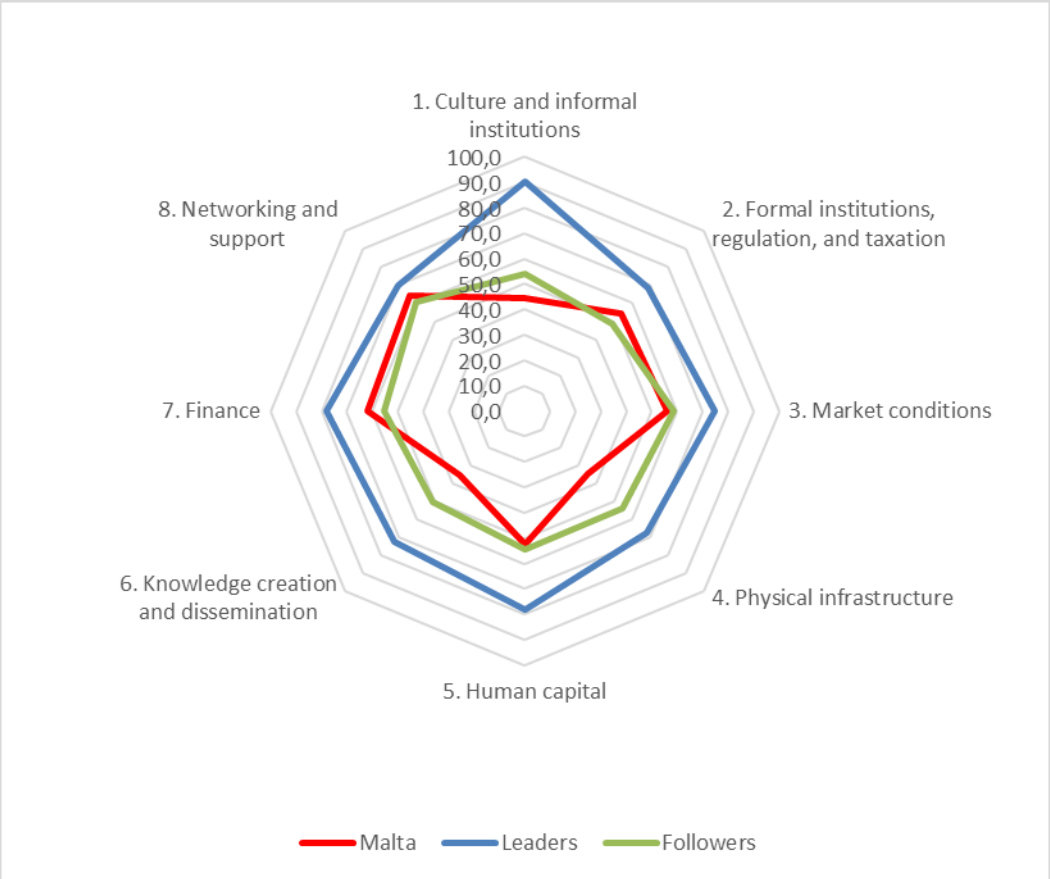


Sum of additional resources for 10% EIDES score increase (in unit per population) 62,0

6.2.19 Malta

Size of population 2016-2018 (in Millions)	0,5
Per capita GDP in Euro 2016-2018 average (PPP)	27 700
Country group	Followers
EIDES rank (score)	13 (48,5)
Digital Entrepreneurship Stand-up sub-index rank (score)	13 (46,9)
Digital Entrepreneurship Start-up sub-index rank (score)	13 (51,1)
Digital Entrepreneurship Scale-up sub-index rank (score)	13 (47,4)

Figure 23. Malta's position in the eight EIDES pillars

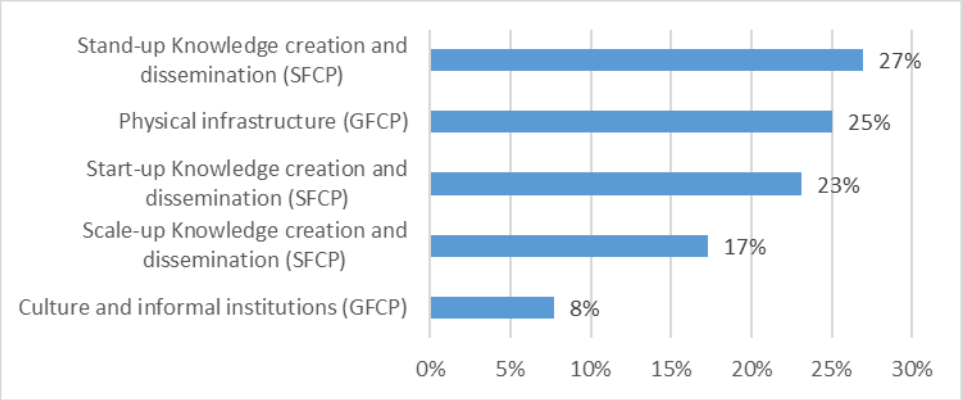


Weakest pillar	Physical infrastructure (35,0)
Strongest pillar	Networking and support (64,2)

Table 44. Malta's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	44,5	74,8	67,7
	Formal institutions, regulation, taxation	54,0	66,7	77,0
	Market conditions	56,0	75,0	69,5
	Physical infrastructure	35,0	78,1	63,3
Systemic Framework Conditions	Human capital	52,2	61,7	72,2
	Knowledge creation and dissemination	35,9	46,5	61,7
	Finance	61,8	50,6	77,2
	Networking and support	64,2	76,9	77,9
EIDES SCORE		**48,5**	**66,3**	**70,8**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	46,9		
	Digital Entrepreneurship Start-up	51,1		
	Digital Entrepreneurship Scale-up	47,4		

Table 45. Malta's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

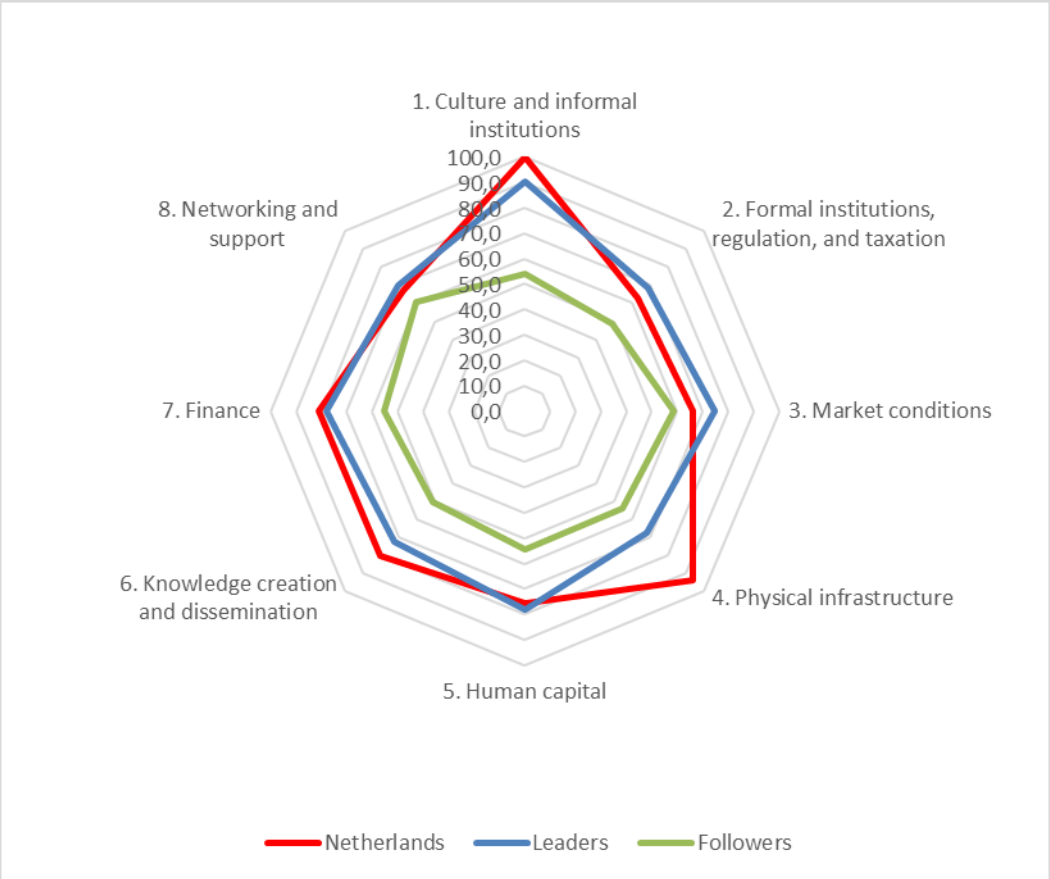


Sum of additional resources for 10% EIDES score increase (in unit per population) 52,0

6.2.20 Netherlands

Size of population 2016-2018 (in Millions)	17,1
Per capita GDP in Euro 2016-2018 average (PPP)	37 876
Country group	Leaders
EIDES rank (score)	3 (72,2)
Digital Entrepreneurship Stand-up sub-index rank (score)	3 (75,2)
Digital Entrepreneurship Start-up sub-index rank (score)	5 (66,8)
Digital Entrepreneurship Scale-up sub-index rank (score)	3 (74,5)

Figure 24. Netherlands's position in the eight EIDES pillars

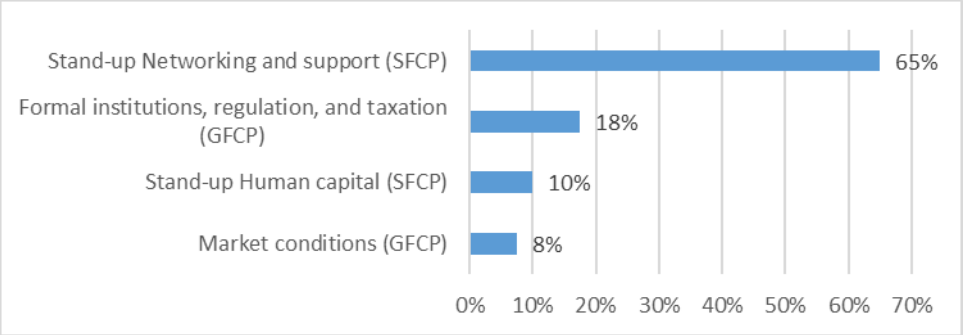


Weakest pillar	Formal institutions, regulation, taxation (63,0)
Strongest pillar	Culture, informal institutions (100,0)

Table 46. Netherlands's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	100,0	93,2	100,0
	Formal institutions, regulation, taxation	63,0	80,6	73,3
	Market conditions	66,0	76,2	75,9
	Physical infrastructure	93,9	99,6	86,8
Systemic Framework Conditions	Human capital	75,8	70,0	87,9
	Knowledge creation and dissemination	80,2	76,1	84,3
	Finance	81,3	53,3	98,1
	Networking and support	67,4	69,9	84,1
EIDES SCORE		**72,2**	**77,4**	**86,3**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	75,2		
	Digital Entrepreneurship Start-up	66,8		
	Digital Entrepreneurship Scale-up	74,5		

Table 47. Netherlands's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

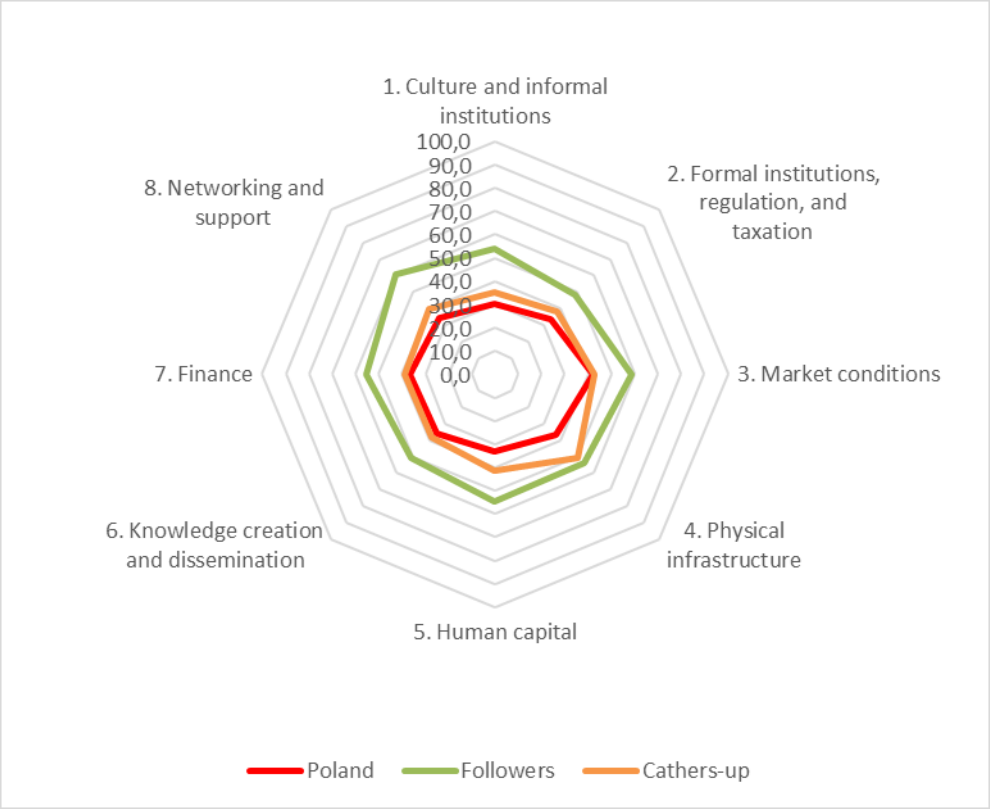


Sum of additional resources for 10% EIDES score increase (in unit per population) 40,0

6.2.21 Poland

Size of population 2016-2018 (in Millions)	38,0
Per capita GDP in Euro 2016-2018 average (PPP)	20 333
Country group	Catchers-up
EIDES rank (score)	20 (35,2)
Digital Entrepreneurship Stand-up sub-index rank (score)	20 (33,4)
Digital Entrepreneurship Start-up sub-index rank (score)	20 (36,7)
Digital Entrepreneurship Scale-up sub-index rank (score)	19 (35,5)

Figure 25. Poland's position in the eight EIDES pillars

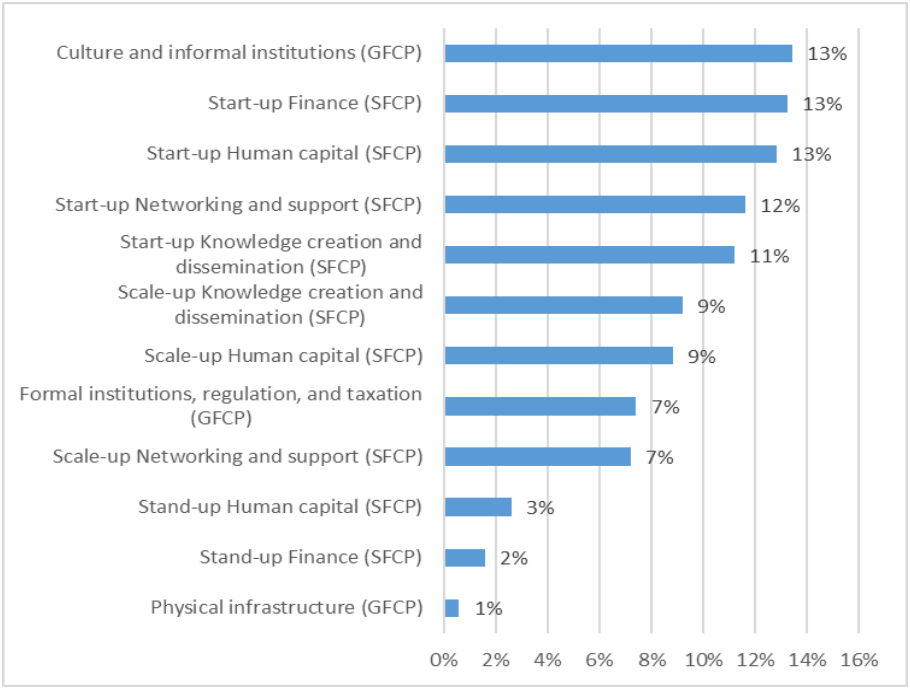


Weakest pillar	Culture, informal institutions (30,5)
Strongest pillar	Market conditions (42,3)

Table 48. Poland's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	30,5	66,8	58,2
	Formal institutions, regulation, taxation	33,6	57,4	56,5
	Market conditions	42,3	74,3	58,9
	Physical infrastructure	37,0	87,3	56,7
Systemic Framework Conditions	Human capital	33,2	55,4	55,1
	Knowledge creation and dis-semination	35,7	46,7	60,5
	Finance	36,7	36,4	53,8
	Networking and support	34,1	56,9	57,7
EIDES SCORE		**35,2**	**60,1**	**57,2**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	33,4		
	Digital Entrepreneurship Start-up	36,7		
	Digital Entrepreneurship Scale-up	35,5		

Table 49. Poland's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

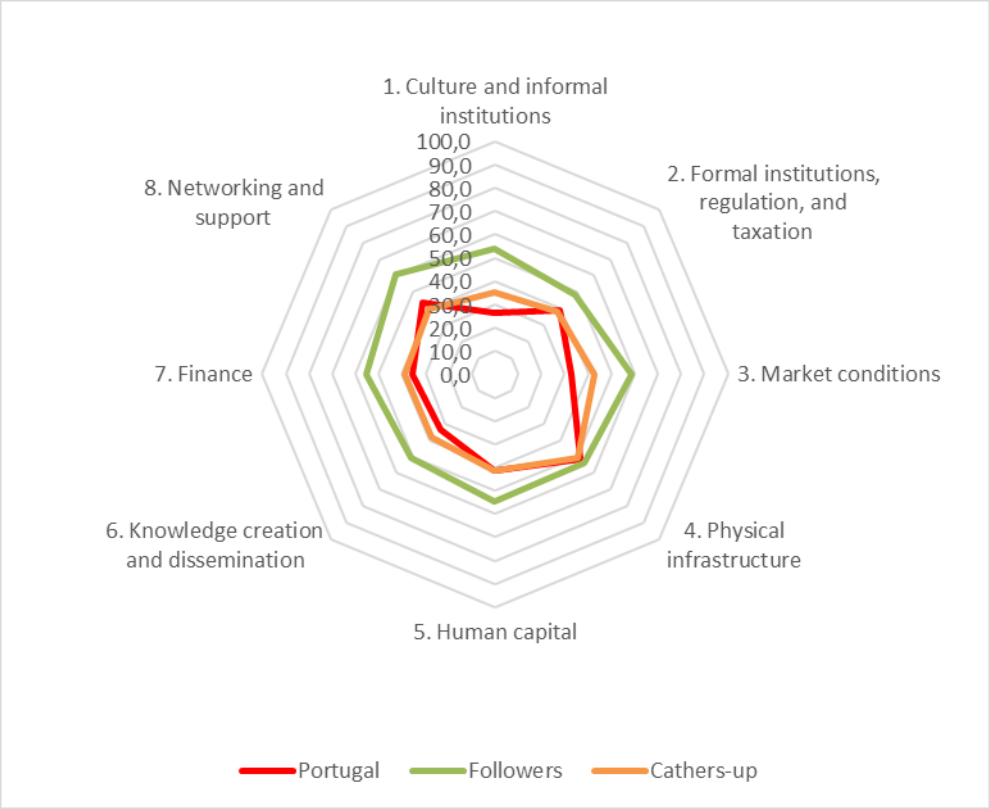


Sum of additional resources for 10% EIDES score increase (in unit per population) 50,0

6.2.22 Portugal

Size of population 2016-2018 (in Millions)	10,3
Per capita GDP in Euro 2016-2018 average (PPP)	22 633
Country group	Catchers-up
EIDES rank (score)	18 (37,1)
Digital Entrepreneurship Stand-up sub-index rank (score)	18 (37,6)
Digital Entrepreneurship Start-up sub-index rank (score)	19 (37,0)
Digital Entrepreneurship Scale-up sub-index rank (score)	18 (36,6)

Figure 26. Portugal's position in the eight EIDES pillars

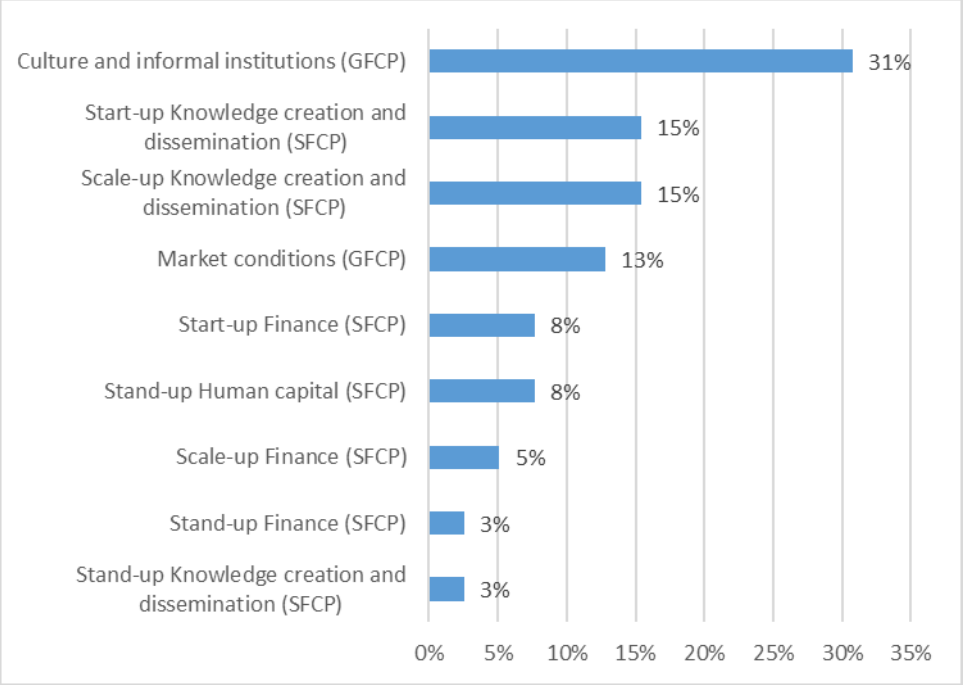


Weakest pillar	Culture, informal institutions (26,2)
Strongest pillar	Physical infrastructure (51,7)

Table 50. Portugal's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	26,2	67,3	48,0
	Formal institutions, regulation, taxation	39,1	64,9	57,7
	Market conditions	32,9	66,4	55,9
	Physical infrastructure	51,7	90,0	67,5
Systemic Framework Conditions	Human capital	41,6	65,8	56,9
	Knowledge creation and dissemination	33,4	54,0	49,5
	Finance	35,3	36,5	52,2
	Networking and support	43,9	64,1	64,5
EIDES SCORE		**37,1**	**63,6**	**56,5**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	37,6		
	Digital Entrepreneurship Start-up	37,0		
	Digital Entrepreneurship Scale-up	36,6		

Table 51. Portugal's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

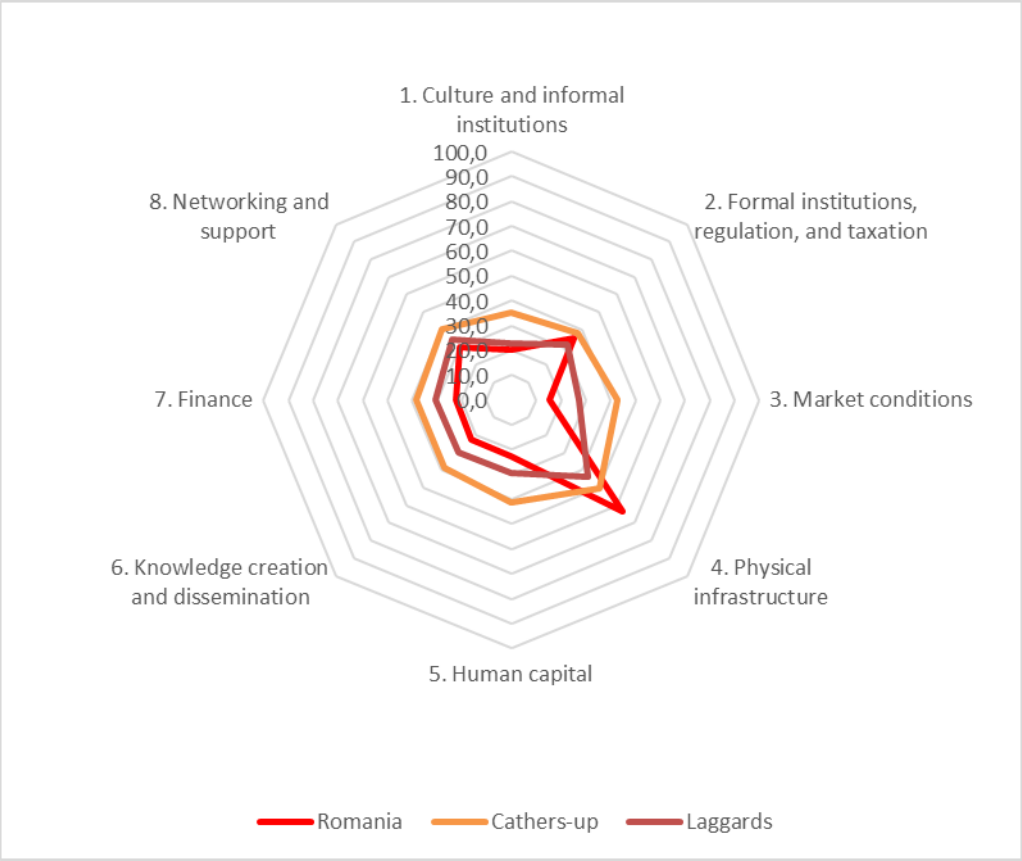


Sum of additional resources for 10% EIDES score increase (in unit per population) 39,0

6.2.23 Romania

Size of population 2016-2018 (in Millions)	19,6
Per capita GDP in Euro 2016-2018 average (PPP)	17 500
Country group	Laggards
EIDES rank (score)	26 (27,1)
Digital Entrepreneurship Stand-up sub-index rank (score)	26 (26,6)
Digital Entrepreneurship Start-up sub-index rank (score)	26 (27,4)
Digital Entrepreneurship Scale-up sub-index rank (score)	26 (27,4)

Figure 27. Romania's position in the eight EIDES pillars

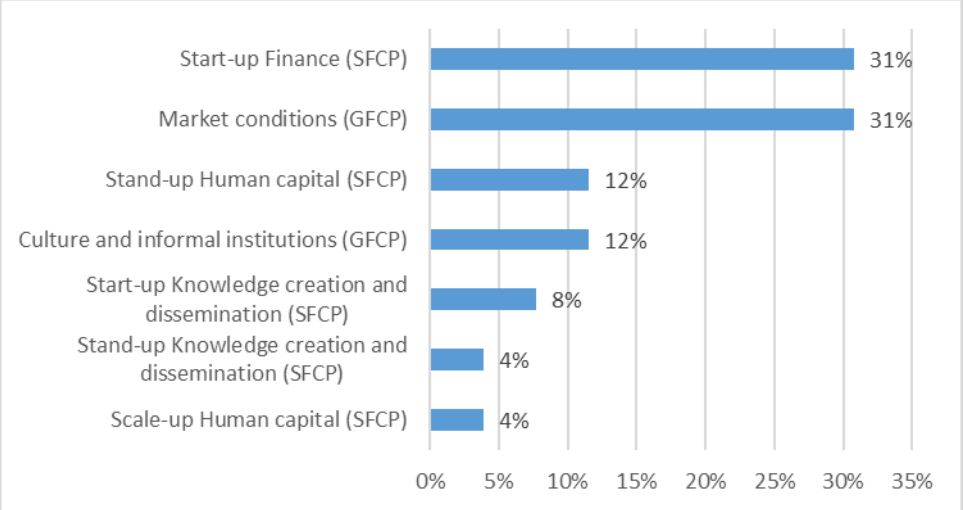


Weakest pillar	Culture, informal institutions (20,2)
Strongest pillar	Physical infrastructure (63,5)

Table 52. Romania's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	20,2	64,0	40,2
	Formal institutions, regulation, taxation	35,4	59,4	57,3
	Market conditions	15,1	65,4	34,9
	Physical infrastructure	63,5	79,0	91,4
Systemic Framework Conditions	Human capital	22,8	50,8	44,2
	Knowledge creation and dis-semination	22,6	35,6	50,9
	Finance	22,2	27,1	37,1
	Networking and support	29,8	61,9	47,6
EIDES SCORE		**27,1**	**55,4**	**50,5**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	26,6		
	Digital Entrepreneurship Start-up	27,4		
	Digital Entrepreneurship Scale-up	27,4		

Table 53. Romania's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

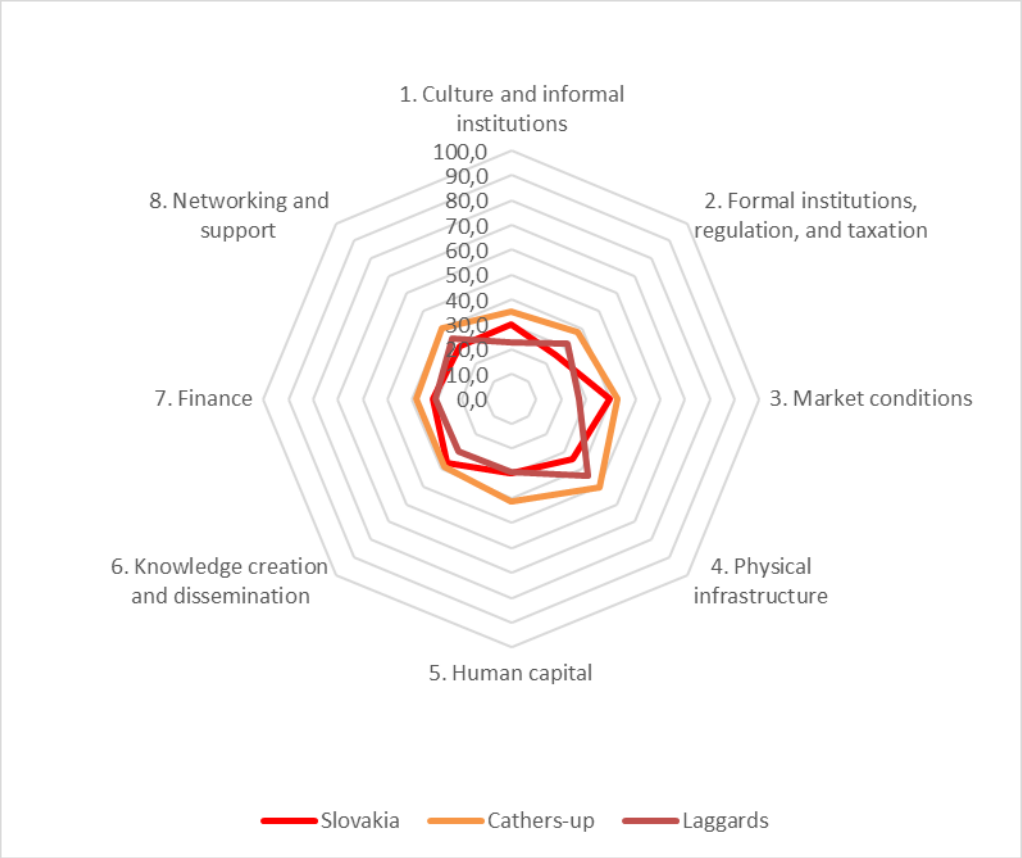


Sum of additional resources for 10% EIDES score increase (in unit per population)	26,0

6.2.24 Slovakia

Size of population 2016-2018 (in Millions)	5,4
Per capita GDP in Euro 2016-2018 average (PPP)	22 567
Country group	Laggards
EIDES rank (score)	24 (31,6)
Digital Entrepreneurship Stand-up sub-index rank (score)	24 (33,0)
Digital Entrepreneurship Start-up sub-index rank (score)	24 (30,8)
Digital Entrepreneurship Scale-up sub-index rank (score)	24 (31,3)

Figure 28. Slovakia's position in the eight EIDES pillars

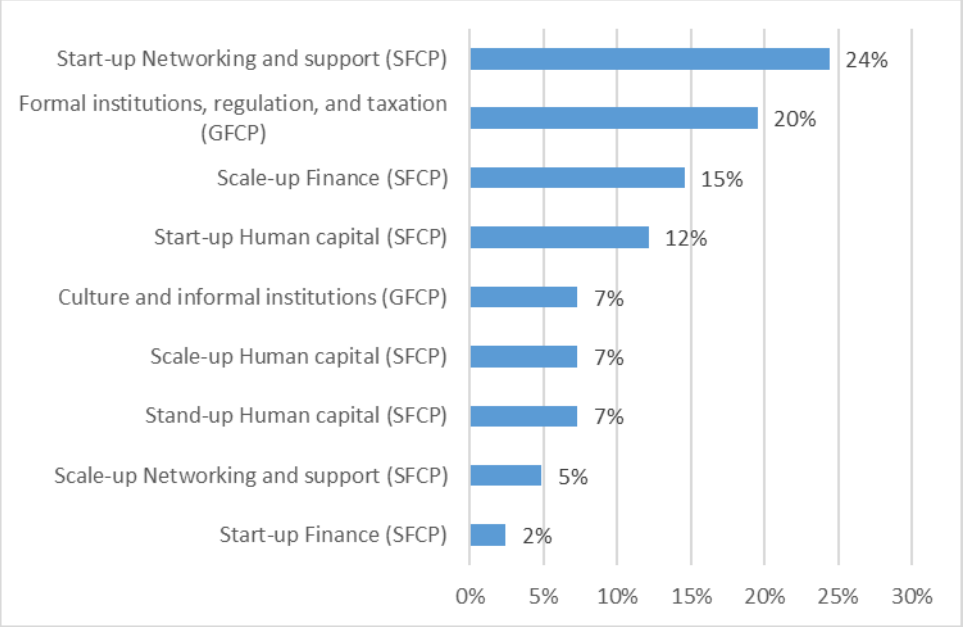


Weakest pillar	Formal institutions, regulation, taxation (25,0)
Strongest pillar	Knowledge creation and dissemination (36,5)

Table 54. Slovakia's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	29,8	64,4	62,2
	Formal institutions, regulation, taxation	25,0	48,3	50,9
	Market conditions	39,7	66,5	62,7
	Physical infrastructure	34,6	84,1	57,0
Systemic Framework Conditions	Human capital	29,9	45,5	59,9
	Knowledge creation and dis-semination	36,5	41,4	69,7
	Finance	31,4	30,3	52,5
	Networking and support	29,7	51,7	55,9
EIDES SCORE		**31,6**	**54,0**	**58,8**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	30,5		
	Digital Entrepreneurship Start-up	33,0		
	Digital Entrepreneurship Scale-up	31,3		

Table 55. Slovakia's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

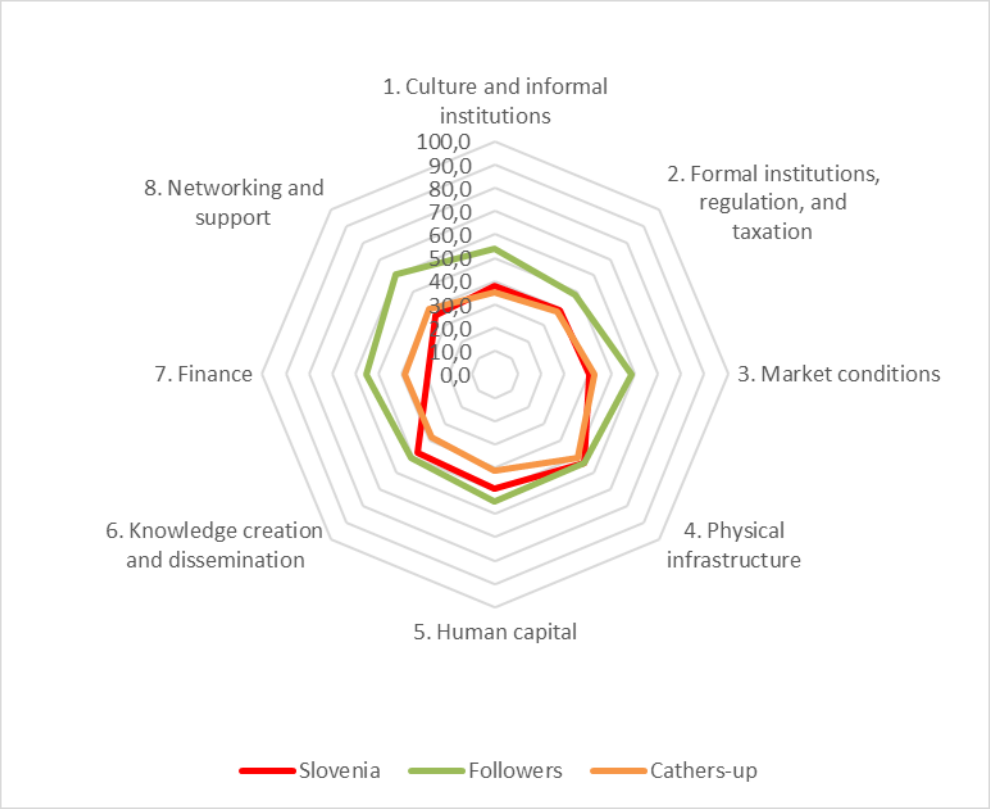


Sum of additional resources for 10% EIDES score increase (in unit per population) 41,0

6.2.25 Slovenia

Size of population 2016-2018 (in Millions)	2,1
Per capita GDP in Euro 2016-2018 average (PPP)	24 467
Country group	Catchers-up
EIDES rank (score)	17 (39,9)
Digital Entrepreneurship Stand-up sub-index rank (score)	17 (38,3)
Digital Entrepreneurship Start-up sub-index rank (score)	17 (42,2)
Digital Entrepreneurship Scale-up sub-index rank (score)	17 (39,1)

Figure 29. Slovenia's position in the eight EIDES pillars

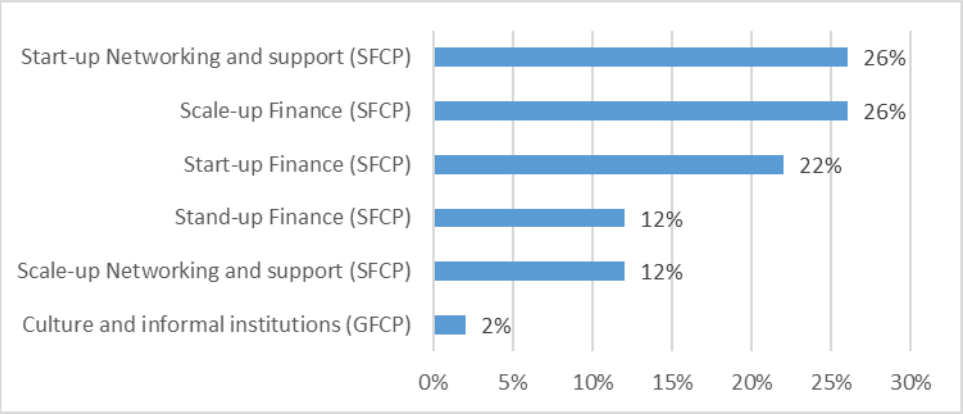


Weakest pillar	Finance (28,7)
Strongest pillar	Physical infrastructure (54,2)

Table 56. Slovenia's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	37,7	69,2	68,3
	Formal institutions, regulation, taxation	39,0	65,4	57,0
	Market conditions	40,6	78,9	54,4
	Physical infrastructure	54,2	82,8	77,7
Systemic Framework Conditions	Human capital	48,8	64,7	65,8
	Knowledge creation and dis-semination	47,3	55,4	67,9
	Finance	28,7	26,8	51,4
	Networking and support	35,9	64,2	54,6
EIDES SCORE		**39,9**	**63,4**	**62,1**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	38,3		
	Digital Entrepreneurship Start-up	42,4		
	Digital Entrepreneurship Scale-up	39,1		

Table 57. Slovenia's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

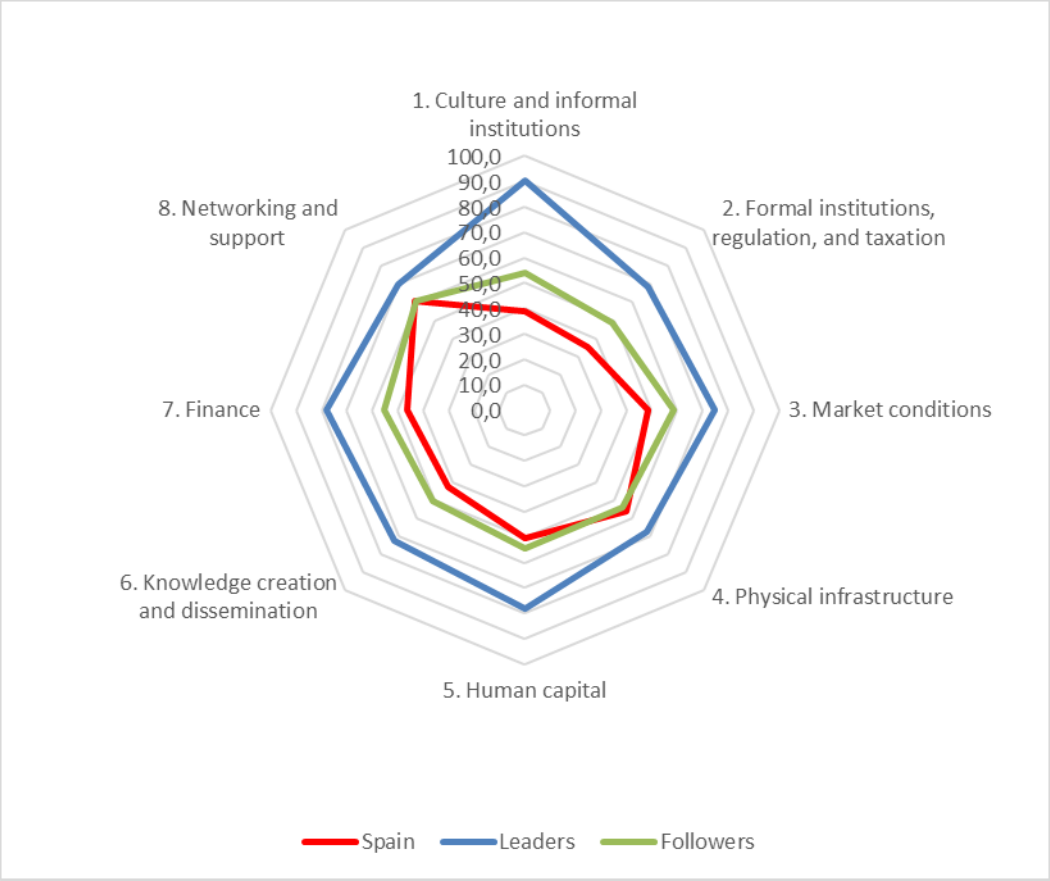


Sum of additional resources for 10% EIDES score increase (in unit per population) 50,0

6.2.26 Spain

Size of population 2016-2018 (in Millions)	46,5
Per capita GDP in Euro 2016-2018 average (PPP)	26 867
Country group	Followers
EIDES rank (score)	14 (46,3)
Digital Entrepreneurship Stand-up sub-index rank (score)	14 (46,5)
Digital Entrepreneurship Start-up sub-index rank (score)	14 (47,2)
Digital Entrepreneurship Scale-up sub-index rank (score)	15 (45,2)

Figure 30. Spain's position in the eight EIDES pillars

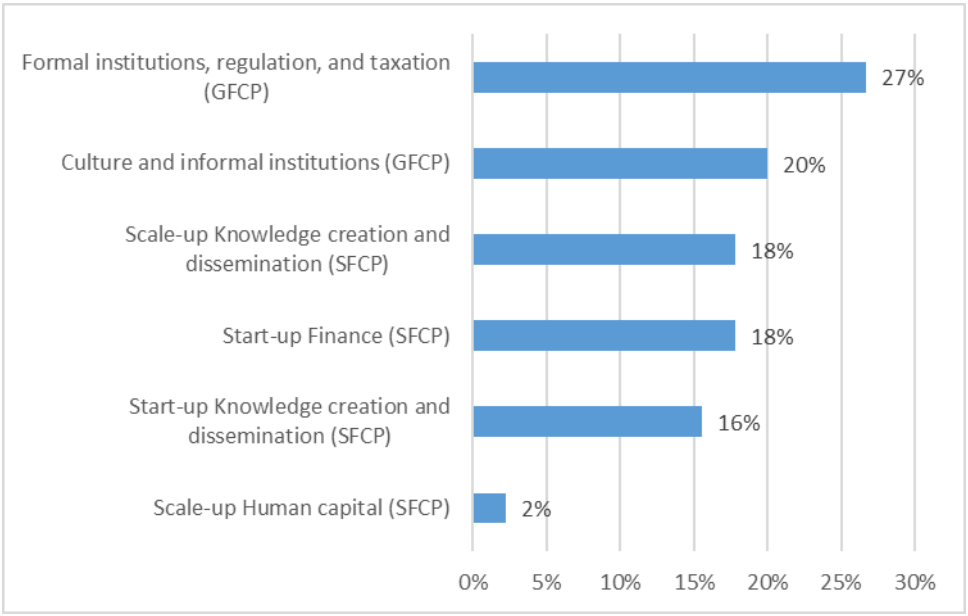


Weakest pillar	Formal institutions, regulation, taxation (35,1)
Strongest pillar	Networking and support (61,0)

Table 58. Spain's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	39,0	71,3	65,6
	Formal institutions, regulation, taxation	35,1	60,1	56,2
	Market conditions	48,4	66,0	71,3
	Physical infrastructure	56,6	96,3	65,5
Systemic Framework Conditions	Human capital	50,3	65,2	66,8
	Knowledge creation and dis-semination	42,7	50,0	67,6
	Finance	46,1	49,7	56,8
	Networking and support	61,0	71,2	76,5
EIDES SCORE		**46,3**	**66,2**	**65,8**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	46,5		
	Digital Entrepreneurship Start-up	47,2		
	Digital Entrepreneurship Scale-up	45,2		

Table 59. Spain's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

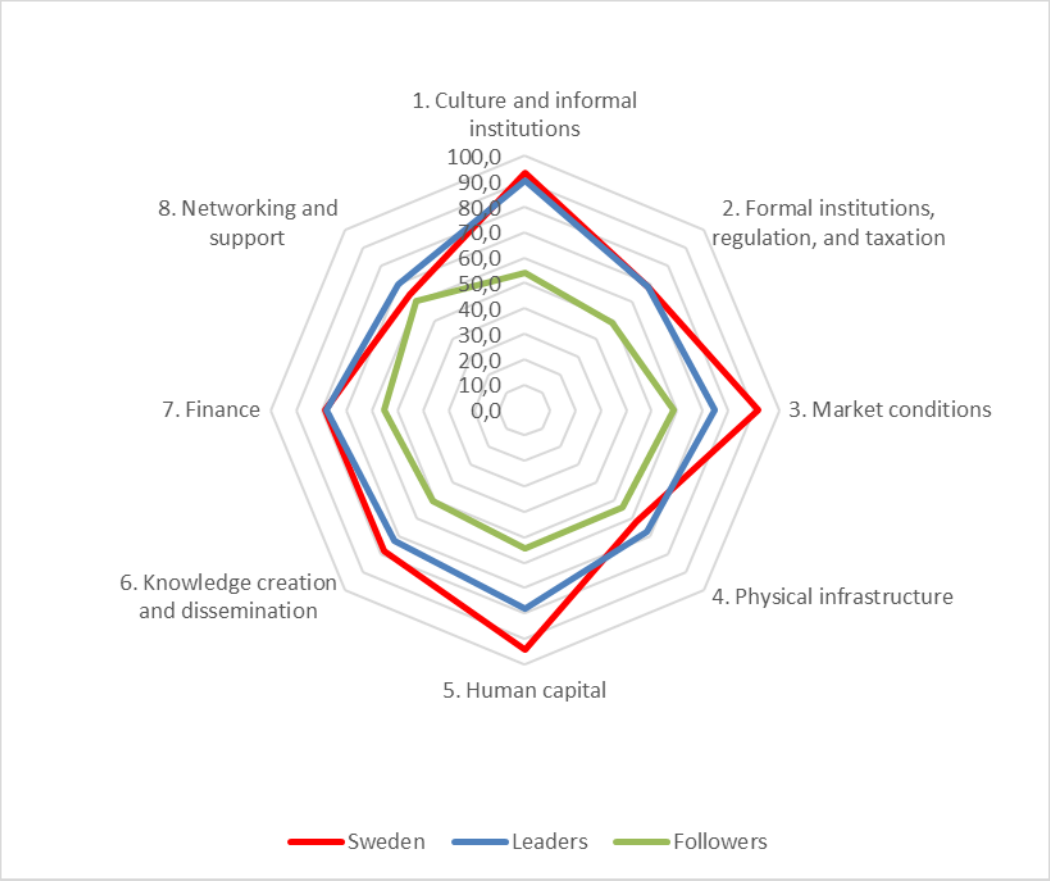


Sum of additional resources for 10% EIDES score increase (in unit per population) 45,0

6.2.27 Sweden

Size of population 2016-2018 (in Millions)	10,0
Per capita GDP in Euro 2016-2018 average (PPP)	36 133
Country group	Leaders
EIDES rank (score)	1 (76,2)
Digital Entrepreneurship Stand-up sub-index rank (score)	2 (77,0)
Digital Entrepreneurship Start-up sub-index rank (score)	1 (73,3)
Digital Entrepreneurship Scale-up sub-index rank (score)	1 (78,3)

Figure 31. Sweden's position in the eight EIDES pillars

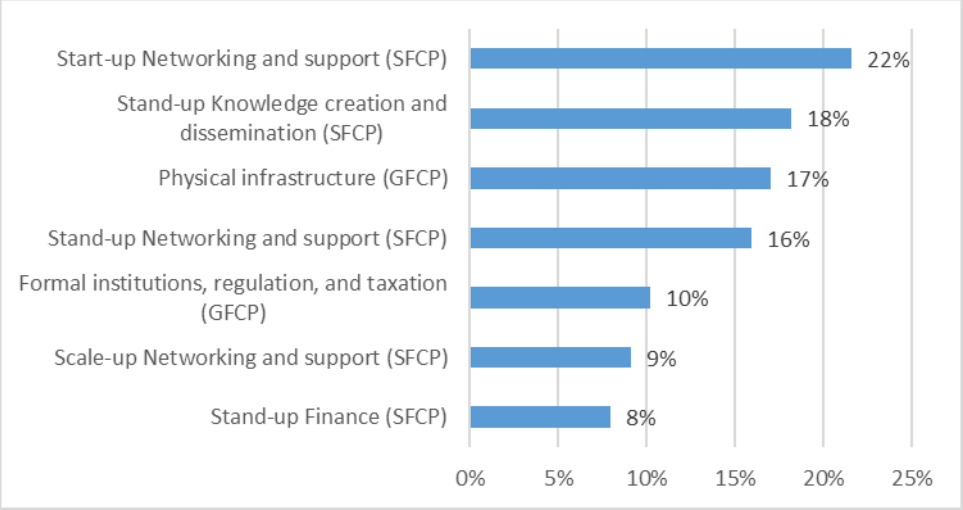


Weakest pillar	Physical infrastructure (62,0)
Strongest pillar	Human capital (94,3)

Table 60. Sweden's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	93,4	94,2	89,9
	Formal institutions, regulation, taxation	68,8	81,0	79,6
	Market conditions	92,1	74,6	95,2
	Physical infrastructure	62,0	90,8	75,1
Systemic Framework Conditions	Human capital	94,3	74,2	100,0
	Knowledge creation and dis-semination	78,0	79,4	78,7
	Finance	78,6	61,6	87,4
	Networking and support	63,9	76,6	75,8
EIDES SCORE		**76,2**	**79,0**	**85,2**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	77,0		
	Digital Entrepreneurship Start-up	73,3		
	Digital Entrepreneurship Scale-up	78,3		

Table 61. Sweden's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score

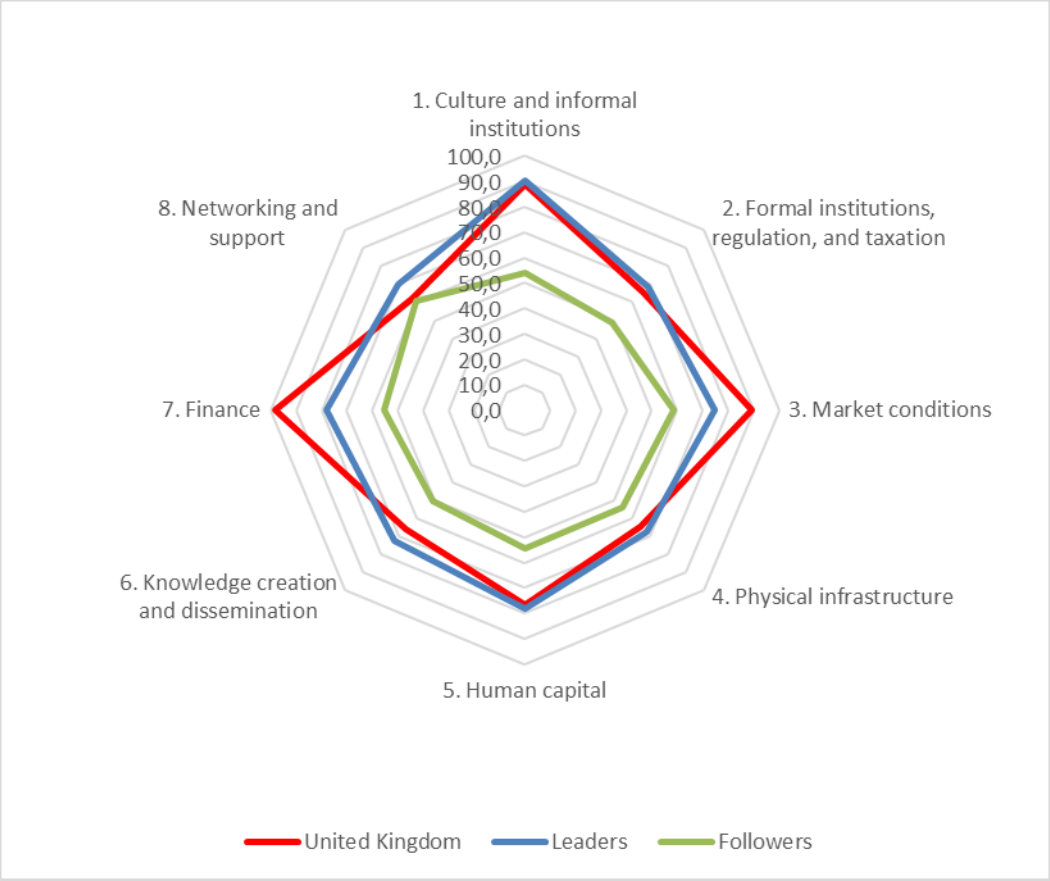


Sum of additional resources for 10% EIDES score increase (in unit per population) 88,0

6.2.28 United Kingdom

Size of population 2016-2018 (in Millions)	65,8
Per capita GDP in Euro 2016-2018 average (PPP)	31 467
Country group	Leaders
EIDES rank (score)	4 (71,5)
Digital Entrepreneurship Stand-up sub-index rank (score)	4 (71,4)
Digital Entrepreneurship Start-up sub-index rank (score)	2 (70,6)
Digital Entrepreneurship Scale-up sub-index rank (score)	4 (72,7)

Figure 32. United Kingdom's position in the eight EIDES pillars

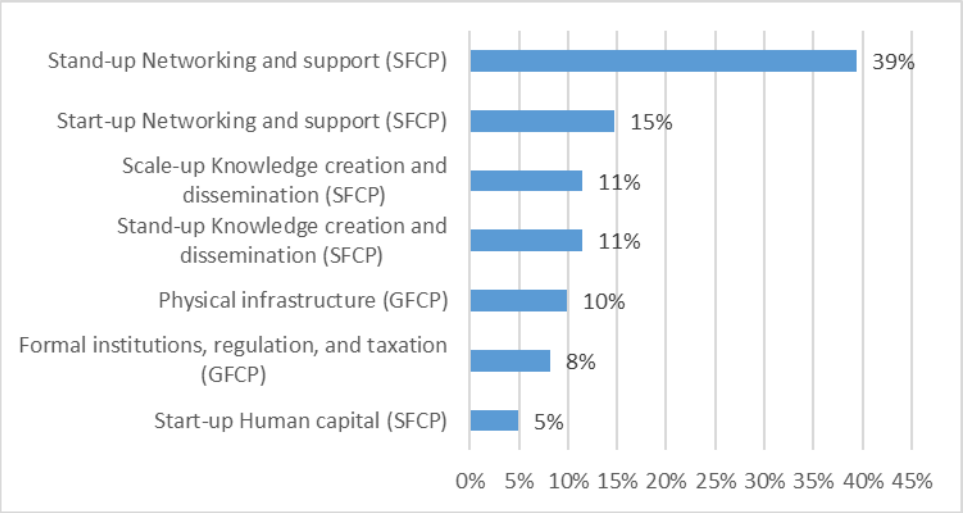


Weakest pillar	Networking and support (62,3)
Strongest pillar	Finance (98,2)

Table 62. United Kingdom's EIDES component values

	CATEGORIES	PILLAR SCORE	NON-DIGITAL SCORE	DIGITAL SCORE
General Framework Conditions	Culture, informal institutions	88,7	93,3	86,7
	Formal institutions, regulation, taxation	65,6	87,0	70,3
	Market conditions	89,5	69,3	100,0
	Physical infrastructure	64,7	95,7	72,0
Systemic Framework Conditions	Human capital	76,4	71,6	86,8
	Knowledge creation and dis-semination	66,3	65,5	80,2
	Finance	98,2	75,5	100,0
	Networking and support	62,3	64,8	84,6
EIDES SCORE		**71,5**	**77,8**	**85,1**
SUB-INDEX		**SUB-INDEX SCORE**		
Sub-indices	Digital Entrepreneurship Stand-up	71,4		
	Digital Entrepreneurship Start-up	70,6		
	Digital Entrepreneurship Scale-up	72,7		

Table 63. United Kingdom's policy optimisation simulation: The allocation of additional resources amongst the pillars to reach a 10% increase in EIDES score



Sum of additional resources for 10% EIDES score increase (in unit per population) 61,0

7 Entrepreneurial Ecosystems: Policy Challenges and Approaches

Entrepreneurial ecosystems are resource allocation systems that facilitate the allocation of resources towards productive uses (Acs, Autio, & Szerb, 2014; Szerb, Acs, Autio, Ortega-Argiles, & Komlosi, 2013). They are enabled by the pervasive trend of digitalisation, which keeps opening up opportunities to re-think the organisation of value-creating activities in the economy through business model innovation (Autio, Cao, Chumjit, Kaensup, & Temsiripoj, 2019). Because of this feature, entrepreneurial ecosystems are a key enabler of progress towards a digital economy (Autio, Nambisan, Thomas, & Wright, 2018b). These characteristics make the entrepreneurial ecosystem phenomenon an important policy object – and also, a challenging one, given that this is a systemic phenomenon, the dynamic of which is not easily reducible to firm-level actions.

The notion of ecosystems implies that the stakeholders of entrepreneurial ecosystems jointly facilitate a system-level outcome – analogous to the notion of an 'ecosystem service' attributed to natural ecosystems (Thomas & Autio, 2019). In entrepreneurial ecosystems, the stakeholders and other elements of the ecosystems can be said to 'co-create' the ecosystem outputs – i.e., innovative new firms that compete with digitally enhanced business models. Collectively, these firms create the 'ecosystem service' – ultimately, advancing a digital economy through the reorganisation of its productive and value-creating activities. The EIDES index has been designed to capture aspects of this important dynamic.

7.1 National and Regional Dimensions of the Policy Challenge

Entrepreneurial ecosystems are predominantly a regional-level phenomenon, a novel type of cluster that exploits opportunities opened up by digitalisation. Entrepreneurial ecosystems are composed of regional communities of stakeholders and specialised resources who specialise in facilitating the stand-up, start-up, and scale-up processes of new ventures that compete with digitally enhanced business models. In the EIDES index, this regional dimension cannot be captured due to lack of available data – instead, the index is composed of pillars reflecting 'general' and 'systemic' framework conditions that regulate the ecosystem's entrepreneurial dynamic. Of these, the general framework conditions represent national-level framework conditions that apply more or less similarly to all regional clusters of entrepreneurial activity in the country. As such, general framework conditions are therefore more amenable to being addressed by country-level operators, such as the legislature and national-level policy agencies. Systemic conditions, on the other hand, tend to exhibit more regional variation, as they reflect characteristics of regional ecosystem communities. Thus, although the EIDES index measures both types of framework conditions using national-level data, the regionalised nature of the entrepreneurial ecosystem phenomenon calls for a combination of both national-level and regional-level policy actions: national-level actions to address general framework conditions, and regional-level actions (supported by national-level policy programmes if necessary) to address systemic framework conditions in regions.

When it comes to national-level, general framework conditions, conventional policy approaches are likely to work also in supporting entrepreneurial ecosystems. Given that general framework conditions apply equally to all kinds of economic activity and regional agglomerations of economic activity, they fall in the category of generic policy actions. Of the four general framework pillars, the physical infrastructure is best addressed through infrastructural investment. The market condition and formal institutions pillars are best addressed through regulatory action that unblocks barriers to market entry, promotes fair competition, discourages monopolies, ensures property protection, alleviates regulatory burden, minimises costs of compliance, and minimises bias resulting from regulatory action. Of the four pillars, the 'informal institutions' pillar is the least amenable to manipulation through regulatory action but is still addressable through education policy (i.e., encouraging entrepreneurial skills and attitudes in the education system), through pro-

motion efforts, and also, through policy actions that lower the opportunity costs of entrepreneurial career choice. Such policies are well established and do not necessarily require novel policy approaches.

In contrast, the regional dimension of entrepreneurial ecosystems does represent novel challenges to policy, ones that arise from their community-centric nature and from the fact that entrepreneurial ecosystems are composed of hierarchically independent participants, whose interests might not always be co-aligned. In their study of the policy management of entrepreneurial ecosystems, Autio and Levie (2017) noted four distinctive policy challenges posed by the characteristics of entrepreneurial ecosystems:

(1) knowledge of the 'inner workings' of an entrepreneurial ecosystem community is both imperfect and unevenly distributed within the ecosystem community and therefore not easily observable from outside the ecosystem
(2) actions taken by individual ecosystem participants may generated cascading effects along complex causal chains, creating the possibility of unintended consequences for policy actions
(3) the interests of ecosystem participants may be imperfectly aligned, giving rise to potential resistance to policy actions
(4) interlocking relationships among ecosystem participants, combined with imperfect understanding how the ecosystem works, can make entrepreneurial ecosystems highly inertial and resistant to policy action

Noting these challenges, Autio and Levie (2017) observed that traditional entrepreneurship policy approaches are not likely to be effective in entrepreneurial ecosystems. These approaches can be categorised into two categories: 'market failure' policies and 'structural failure' policies (Acs et al., 2014). Market failure policies address specific, externally observable 'market failures' in economic systems. Such market failures usually arise from the 'failure' of the market pricing mechanism to correctly price certain desired actions, thereby creating a disincentive for such action (Arrow, 1962). A classic example concerns investment in innovative activity and R&D: because R&D activities are both uncertain and their outcomes prone to leak, firms are discouraged to invest in such activity. This is because it is not guaranteed that investments in R&D will result in meaningful, value-adding technological advances, and even if it did, there is a risk that competitors could quickly copy such advances and thus neutralise the resulting advantage for the inventor. Because of such concerns, firms might not invest sufficiently in R&D, with the result that positive system-wide effects resulting from knowledge spill-overs fail to materialise. Such a failure is normally fairly straightforward to address through policy action because it is possible to observe the failure from outside (firms under-invest in R&D) and address it through targeted, top-down policy action (create an R&D subsidy to incentivise firms to invest in R&D). Such top-down, targeted policy action is easy to address through conventional policy action, by instituting a law legalising such subsidies and assigning the administration of these to an appropriate policy agency.

The other conventional approach to entrepreneurship and innovation policy seeks to similarly observe and fix 'structural failures' in national and regional systems of innovation. This approach reflects the institutional emphasis of the systems of innovation literature and seeks to fix structural gaps in national and regional institutional landscapes designed to support innovative activity (Edquist & Johnson, 1997). As an example of a structural failure, an analysis of a given regional system of innovation might notice a lack of bridging institutions to connect research advances achieved in universities and research institutions to empirical application. Such a gap could be addressed, for example, by setting up a technology licensing office, or by establishing a science park to support spin-out companies that commercialise advances in basic and applied research. The primary emphasis, thus, is in fixing structural gaps by building new institutional structures such as science parks. Similar to market failure policy, also structural failure policy measures would identify externally observable gaps in national and regional innovation structures and plug these through top-down policy action.

Given the characteristics of entrepreneurial ecosystems highlighted above, traditional, 'top-down' policies may not be effective in addressing what we would like to call 'ecosystem failures'. This is because of several reasons:

- whereas both 'market' and 'structural' failures tend to be quite static and enduring, ecosystem failures tend to be dynamic and emergent, being co-produced by ecosystem participant interactions
- whereas both 'market' and 'structural' failures can be observed from 'outside' (i.e., by an external observer), the patterns of participant interactions are less easy to observe by an outsider – and being embedded in dyadic interactions between ecosystem participants, difficult to observe even for most insiders
- whereas both 'market' and 'structural' failure correction lend themselves for corrective action in a top-down mode, the hierarchically independent (yet mutually co-dependent) nature of ecosystem participants, combined by their sometimes limited awareness of other ecosystem participants, render 'top-down' actions more difficult in entrepreneurial ecosystem contexts
- whereas both 'market' and 'structural' failures can be addressed from the outside, many ecosystem failures can only be addressed from the inside
- whereas both 'market' and 'structural' failures can be effectively addressed with highly specific actions, more broad-based and orchestrated actions are required to overcome ecosystem inertia

Because of these challenges, effective policies targeting entrepreneurial ecosystems need to:

- be operated in a bottom-up mode
- actively engage ecosystem participants in a collective effort to both promote mutual awareness among ecosystem participants, foster productive interactions among these, distil a shared understanding of what the ecosystem entails and how it operates, where the gaps are, and what collective actions are required to address them
- focus on coordination of emergent actions and understandings among heterogeneous participants (as opposed to top-down implementation of predetermined actions)
- when necessary, orchestrate ecosystem actions with specific top-down actions such as targeted subsidies
- be long term to allow time to overcome ecosystem inertia
- employ broad-based monitoring of ecosystem dynamics and processes over time

To this end, Autio and Levie (2017) and Autio et al. (2018a), based on ecosystem facilitation experiments conducted in Scotland, Estonia, and Thailand, proposed the following heuristic for facilitating entrepreneurial ecosystems:

- create a core group of 6-8 central and committed ecosystem stakeholders, tasked with coordinating the regional entrepreneurial ecosystem facilitation initiative
- create an early analysis of the regional entrepreneurial ecosystem, using a measurement template such as the Entrepreneurial Ecosystem Maturity Model (Autio & Cao, 2019)
- organise three workshops, with appropriate intervals, with participation by some 20 ecosystem participants representing different perspectives to the ecosystem – the first focusing on understanding the ecosystem workings and bottlenecks, the second on bottleneck drivers and possible solutions, and the third on actions required to improve the ecosystem functioning
- organise a post-workshop implementation agenda and a monitoring system to monitor progress

7.2 Recommended Use of EIDES Data in Entrepreneurial Ecosystem Policy Design

As noted, the EIDES index covers both national-level, general framework conditions and national-level data concerning the more regional dimension of entrepreneurial ecosystems, as captured in systemic framework conditions. The country pages of this report provide an overview of each country's EIDES data, including the policy optimisation simulation. This data and the simulation provide a good starting point for entrepreneurial ecosystem policy design in different countries.

Several general observations can be made from the country-level EIDES data:

- First, in most countries, the general and systemic framework conditions tend to perform at a similar level. There do not appear to be systematic patterns in terms of the relative performance of each group of framework conditions.
- Nevertheless, this general pattern means that countries with a lower overall performance may need to invest relatively greater effort to improving general framework conditions, as these regulate all types of business and can also significantly hamper regional dynamics (e.g., market conditions and formal institutional conditions).
- The bulk of policy attention should be focused at those pillars that are flagged as the more significant bottlenecks in the policy simulation. In some countries, specific pillars are flagged as particularly important bottlenecks, whereas in others, policy attention should focus on two or more pillars. The general objective should be to achieve a good balance across the index pillars.
- Attention should be paid to both digitalised pillar scores and non-digitalised pillar scores. This also implies the need for coordination between digitalisation policy and entrepreneurial ecosystem policy.
- The EIDES data should be treated as a starting point that feeds into the ecosystem facilitation heuristic as described above and not as the final prescription. The emphasis in regional-level ecosystem facilitation should be in facilitating sense-making regarding the functioning of regional entrepreneurial ecosystems, and more detailed analyses should be carried out during the regional facilitation projects using region-specific data, as collected, for example, using the Entrepreneurial Ecosystem Maturity Model (Autio & Cao, 2019).

7.3 Entrepreneurial Ecosystems and Digitalisation: General Policy Recommendations

Entrepreneurial ecosystem policy needs to take a comprehensive look at both stand-up, start-up and scale-up systems and consider ecosystem dynamics as a whole.

As policy attention shifts towards scale-up dynamics, the less effective firm-specific policy actions are likely to be, and the greater will be the need to consider system-level dynamics and systemic framework conditions.

Ecosystem-specific policy initiatives should be designed and implemented in coordination with support initiatives in the 'market' and 'system failure' modes. The latter may not be effective in addressing ecosystem failures, especially if implemented in isolation.

In order to be successful, entrepreneurial ecosystem policies need to actively engage ecosystem stakeholders. A top-down approach is not likely to work in an ecosystem where most stakeholders are hierarchically independent.

To be effective, entrepreneurial ecosystem policies need to: (a) facilitate identification by the ecosystem participants with the broader ecosystem; (b) strengthen commitment among ecosystem stakeholders to coordinate their actions – and actively identify and address dynamic ecosystem failures.

Entrepreneurial ecosystem policies require a long-term approach, as 'quick fixes' are likely to be rare. Therefore, successful ecosystem interventions need to be coordinated and facilitated by a credible, committed backbone organisation in order to ensure that sufficient momentum is maintained to overcome ecosystem inertia.

An ecosystems approach to entrepreneurship policy is likely to present considerable challenges to policy-making and implementing agencies, as these tend to be moulded in the traditional, 'top-down' mode of policy-making. A key to overcoming this challenge is operating in partnership with and through regional backbone organisations who command sufficient authority and commitment to take on long-term ecosystem facilitation processes.

In order to successfully implement an EU-wide entrepreneurial ecosystem policy, that policy needs to: (a) combine region-specific and national approaches; (b) recognise that ecosystem structures and processes will be different at different levels of policy deployment (e.g., regional, national, EU-wide); (c) foster learning and experience exchange across regions; (d) assume an ecosystem-wide approach to understanding how those ecosystem work (see also Autio (2016)).

Given that the entrepreneurial ecosystem phenomenon is ultimately driven by digitalisation, close coordination is needed between entrepreneurial ecosystem and digitalisation policies.

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Annex 1. Calculation of the EIDES Scores

In constructing the index we followed eleven steps:

1. **Normalisation of indicators**: Altogether we have selected 116 indicators. Out of these there are 23 general framework entrepreneurship, 39 systemic framework entrepreneurship, 26 general framework digital and 27 systemic framework digital indicators. First, we normalised all the indicators using the distance methodology:

$$x_{i,k} = \frac{z_{i,j}}{\max z_{i,j}} \qquad (1)$$

for all i= 1….28, the number of countries
j= 1 ... 121, the number of indicators
where $x_{i,j}$ is the normalised indicator score value for country i and indicator j
$z_{i,j}$ is the original indicator value for country i and indicator j

2. ***The construction of the variables:*** We calculate all variables from the indicators by calculating the simple arithmetic averages. Altogether we have 24 variables, 16 entrepreneurship and eight digital variables.

The four general framework entrepreneurship variables are calculated as follows:

$$\mathrm{GFC\_P1}_i = \frac{\sum_1^6 \mathrm{x_{i,j}}}{6} \qquad (2a)$$

$$\mathrm{GFC\_P2}_i = \frac{\sum_7^{13} \mathrm{x_{i,j}}}{7} \qquad (2b)$$

$$\mathrm{GFC\_P3}_i = \frac{\sum_{14}^{20} \mathrm{x_{i,j}}}{7} \qquad (2c)$$

$$\mathrm{GFC\_P1}_i = \frac{\sum_{21}^{23} \mathrm{x_{i,j}}}{3} \qquad (2d)$$

for all countries i
GFC_P1=Culture and Informal Institution entrepreneurship
GFC_P2= Formal Institutions and Regulatory Framework entrepreneurship
GFC_P3=Market Conditions entrepreneurship
GFC_P4= Physical Infrastructure entrepreneurship

The systemic entrepreneurship variables are calculated independently for the three stages.

$$\mathrm{S1\_SEC\_P1}_i = \frac{\sum_{24}^{25} \mathrm{x_{i,j}}}{2} \qquad (2e)$$

$$\mathrm{S2\_SEC\_P1}_i = \frac{\sum_{26}^{29} \mathrm{x_{i,j}}}{4} \qquad (2f)$$

$$\mathrm{S3\_SEC\_P1}_i = \frac{\sum_{30}^{33} \mathrm{x_{i,j}}}{4} \qquad (2g)$$

S1_SEC_P1= Human Capital entrepreneurship Stand-up
S2_SEC_P1= Human Capital entrepreneurship Start-up

S3_SEC_P1= Human Capital entrepreneurship Scale-up

$$\mathrm{S1\_SEC\_P2}_i = \frac{\sum_{34}^{35} \mathrm{x_{i,j}}}{2} \quad (2h)$$

$$\mathrm{S2\_SEC\_P2}_i = \frac{\sum_{36}^{37} \mathrm{x_{i,j}}}{2} \quad (2i)$$

$$\mathrm{S3\_SEC\_P2}_i = \frac{\sum_{38}^{44} \mathrm{x_{i,j}}}{7} \quad (2j)$$

S1_SEC_P2= Knowledge creation, transfer and absorption entrepreneurship Stand-up
S2_SEC_P2= Knowledge creation, transfer and absorption entrepreneurship Start-up
S3_SEC_P2= Knowledge creation, transfer and absorption entrepreneurship Scale-up

$$\mathrm{S1\_SEC\_P3}_i = \frac{\sum_{45}^{46} \mathrm{x_{i,j}}}{2} \quad (2k)$$

$$\mathrm{S2\_SEC\_P3}_i = \frac{\sum_{47}^{52} \mathrm{x_{i,j}}}{6} \quad (2l)$$

$$\mathrm{S3\_SEC\_P3}_i = \frac{\sum_{53}^{56} \mathrm{x_{i,j}}}{4} \quad (2m)$$

S1_SEC_P3= Finance entrepreneurship Stand-up
S2_SEC_P3= Finance entrepreneurship Start-up
S3_SEC_P3= Finance entrepreneurship Scale-up

$$\mathrm{S1\_SEC\_P4}_i = \frac{\sum_{57}^{57} \mathrm{x_{i,j}}}{1} \quad (2n)$$

$$\mathrm{S2\_SEC\_P4}_i = \frac{\sum_{58}^{59} \mathrm{x_{i,j}}}{2} \quad (2o)$$

$$\mathrm{S3\_SEC\_P4}_i = \frac{\sum_{60}^{62} \mathrm{x_{i,j}}}{3} \quad (2p)$$

S1_SEC_P4= Networking and support entrepreneurship Stand-up
S2_SEC_P4= Networking and support entrepreneurship Start-up
S3_SEC_P4= Networking and support entrepreneurship Scale-up

The calculation of the digital variables follows exactly the same logic.

The four general framework digital variables are calculated as follows:

$$\mathrm{DFC\_P1}_i = \frac{\sum_{63}^{66} \mathrm{x_{i,j}}}{4} \quad (2a)$$

$$\mathrm{DFC\_P2}_i = \frac{\sum_{67}^{72} \mathrm{x_{i,j}}}{6} \quad (2b)$$

$$\mathrm{DFC\_P3}_i = \frac{\sum_{73}^{79} \mathrm{x_{i,j}}}{7} \quad (2c)$$

$$\mathrm{DFC\_P1}_i = \frac{\sum_{80}^{88} \mathrm{x_{i,j}}}{9} \quad (2d)$$

for all countries

DFC_P1=Culture and Informal Institution digital
DFC_P2= Formal Institutions and Regulatory Framework digital
DFC_P3=Market Conditions digital
DFC_P4= Physical Infrastructure digital

The systemic digital variables are also calculated independently for the three stages.

$$S1\_SDC\_P1_i = \frac{\sum_{89}^{91} x_{i,j}}{3} \quad (2e)$$

$$S2\_SDC\_P1_i = \frac{\sum_{92}^{92} x_{i,j}}{1} \quad (2f)$$

$$S3\_SDC\_P1_i = \frac{\sum_{93}^{94} x_{i,j}}{2} \quad (2g)$$

S1_SDC_P1= Human Capital digital Stand-up
S2_SDC_P1= Human Capital digital Start-up
S3_SDC_P1= Human Capital digital Scale-up

$$S1\_SDC\_P2_i = \frac{\sum_{95}^{97} x_{i,j}}{3} \quad (2h)$$

$$S2\_SDC\_P2_i = \frac{\sum_{98}^{99} x_{i,j}}{2} \quad (2i)$$

$$S3\_SDC\_P2_i = \frac{\sum_{200}^{101} x_{i,j}}{2} \quad (2j)$$

S1_SDC_P2= Knowledge creation, transfer and absorption digital Stand-up
S2_SDC_P2= Knowledge creation, transfer and absorption digital Start-up
S3_SDC_P2= Knowledge creation, transfer and absorption digital Scale-up

$$S1\_SDC\_P3_i = \frac{\sum_{102}^{104} x_{i,j}}{3} \quad (2k)$$

$$S2\_SDC\_P3_i = \frac{\sum_{105}^{105} x_{i,j}}{1} \quad (2l)$$

$$S3\_SDC\_P3_i = \frac{\sum_{106}^{106} x_{i,j}}{1} \quad (2m)$$

S1_SDC_P3= Finance digital Stand-up
S2_SDC_P3= Finance digital Start-up
S3_SDC_P3= Finance digital Scale-up

$$S1\_SDC\_P4_i = \frac{\sum_{107}^{108} x_{i,j}}{2} \quad (2n)$$

$$S2\_SDC\_P4_i = \frac{\sum_{109}^{112} x_{i,j}}{4} \quad (2o)$$

$$S3\_SDC\_P4_i = \frac{\sum_{113}^{116} x_{i,j}}{3} \quad (2p)$$

S1_SDC_P4= Networking and support digital Stand-up
S2_SDC_P4= Networking and support digital Start-up
S3_SDC_P4= Networking and support digital Scale-up

3. ***Normalisation of the variables:*** variables are normalised again to a range from 0 to 1:

$$m(norm)_{i,l} = \frac{m_{i,l}}{\max m_{i,l}} \qquad (3)$$

for all l= 1 ... 24, the number of variables
where $m(norm)_{i,j}$ is the normalised score value for country i and variable j
$m_{i,l}$ is the original pillar value for country i and variable l
$max\ m_{i,l}$ is the maximum value for variable l

4. ***Digital systemic variable calculation:*** Our original idea was to match the entrepreneurship and the digital variables one by one. Unfortunately some of the digital systemic variables contain on a few or in three cases only one indicator. Therefore their reliability is not as high as the systemic entrepreneurship component values. So we decided to calculate only one digital component for all four systemic digital variables.

$$\mathrm{SDC\_P1}_i = \frac{\sum_1^3 \mathrm{S(s)\_SDC\_P1_{i,s}}}{3} \qquad (4a)$$

$$\mathrm{SDC\_P2}_i = \frac{\sum_1^3 \mathrm{S(s)\_SDC\_P1_{i,s}}}{3} \qquad (4a)$$

$$\mathrm{SDC\_P3}_i = \frac{\sum_1^3 \mathrm{S(s)\_SDC\_P1_{i,s}}}{3} \qquad (4a)$$

$$\mathrm{SDC\_P4}_i = \frac{\sum_1^3 \mathrm{S(s)\_SDC\_P1_{i,s}}}{3} \qquad (4a)$$

where SDC_P1, SDC_P2, SDC_P3, SDC_P4 are the systemic digital variable for all country i
and the S(s)_SDC_P1; S(s)_SDC_P2; S(s)_SDC_P2; S(s)_SDC_P4 are the systemic digital variables for stages s=1,2,3

5. **Normalisation of the digital systemic variables:** Similar to the previous cases we calculate the normalised scores for the four digital systemic variables

$$m(norm)_{i,l} = \frac{m_{i,l}}{\max m_{i,l}} \qquad (5)$$

for all l= 20 ... 24, the number of variables
where $m(norm)_{i,l}$ is the normalised variable score value for country i and variable l
$m_{i,l}$ is the original digital variable value for country i and variable l
$max\ m_{i,l}$ is the maximum value for variable l

6. **Pillar calculation:** There are altogether 16 pillars in the digital entrepreneurship ecosystem index. All 16 pillars are the result of the multiplication of the digital ecosystem variable and the associated digital variable.

   For the general framework condition the digital entrepreneurship pillars are the followings:

$$\mathrm{GDFC\_P1}_i = \mathrm{GFC\_P1_i} * \mathrm{DFC\_P1_i} \qquad (6a)$$

$$\mathrm{GDFC\_P2}_i = \mathrm{GFC\_P2_i} * \mathrm{DFC\_P2_i} \qquad (6b)$$

$$\mathrm{GDFC\_P3}_i = \mathrm{GFC\_P3_i} * \mathrm{DFC\_P3_i} \qquad (6c)$$

$$\mathrm{GDFC\_P4}_i = \mathrm{GFC\_P4}_\mathrm{i} * \mathrm{DFC\_P4}_\mathrm{i} \quad (6d)$$

where:

GDFC_P1=Culture and Informal Institution digital entrepreneurship pillar
GDFC_P2= Formal Institutions and Regulatory Framework digital entrepreneurship pillar
GDFC_P3=Market Conditions digital entrepreneurship pillar
GDFC_P4= Physical Infrastructure digital entrepreneurship pillar

For the systemic framework conditions the digital entrepreneurship pillars are calculated separately for all three stages.

For the Stand-up stage:

$$\mathrm{S1\_SDEC\_P1}_i = \mathrm{S1\_SEC\_P1}_\mathrm{i} * \mathrm{SDC\_P1}_\mathrm{i} \quad (6e)$$

$$\mathrm{S1\_SDEC\_P2}_i = \mathrm{S1\_SEC\_P2}_\mathrm{i} * \mathrm{SDC\_P2}_\mathrm{i} \quad (6f)$$

$$\mathrm{S1\_SDEC\_P3}_i = \mathrm{S1\_SEC\_P3}_\mathrm{i} * \mathrm{SDC\_P3}_\mathrm{i} \quad (6g)$$

$$\mathrm{S1\_SDEC\_P4}_i = \mathrm{S1\_SEC\_P4}_\mathrm{i} * \mathrm{SDC\_P4}_\mathrm{i} \quad (6h)$$

where:

S1_SDEC_P1=Human capital Stand-up digital entrepreneurship pillar
S1_SDEC_P2= Knowledge creation, transfer and absorption Stand-up digital entrepreneurship pillar
S1_SDEC_P3=Finance Stand-up digital entrepreneurship pillar
S1_SDEC_P4= Networking and support Stand-up digital entrepreneurship pillar

For the Start-up stage:

$$\mathrm{S2\_SDEC\_P1}_i = \mathrm{S2\_SEC\_P1}_\mathrm{i} * \mathrm{SDC\_P1}_\mathrm{i} \quad (6i)$$

$$\mathrm{S2\_SDEC\_P2}_i = \mathrm{S2\_SEC\_P2}_\mathrm{i} * \mathrm{SDC\_P2}_\mathrm{i} \quad (6j)$$

$$\mathrm{S2\_SDEC\_P3}_i = \mathrm{S2\_SEC\_P3}_\mathrm{i} * \mathrm{SDC\_P3}_\mathrm{i} \quad (6k)$$

$$\mathrm{S2\_SDEC\_P4}_i = \mathrm{S2\_SEC\_P4}_\mathrm{i} * \mathrm{SDC\_P4}_\mathrm{i} \quad (6l)$$

where:

S2_SDEC_P1=Human capital Start-up digital entrepreneurship pillar
S2_SDEC_P2= Knowledge creation, transfer and absorption Start-up digital entrepreneurship pillar
S2_SDEC_P3=Finance Start-up digital entrepreneurship pillar
S2_SDEC_P4= Networking and support Start-up digital entrepreneurship pillar

For the Scale-up stage:

$$\mathrm{S3\_SDEC\_P1}_i = \mathrm{S3\_SEC\_P1}_\mathrm{i} * \mathrm{SDC\_P1}_\mathrm{i} \quad (6m)$$

$$\mathrm{S3\_SDEC\_P2}_i = \mathrm{S3\_SEC\_P2}_\mathrm{i} * \mathrm{SDC\_P2}_\mathrm{i} \quad (6n)$$

$$S3\_SDEC\_P3_i = S3\_SEC\_P3_i * SDC\_P3_i \quad (6o)$$

$$S3\_SDEC\_P4_i = S3\_SEC\_P4_i * SDC\_P4_i \quad (6p)$$

where:

S3_SDEC_P1=Human capital Scale-up digital entrepreneurship pillar
S3_SDEC_P2= Knowledge creation, transfer and absorption Scale-up digital entrepreneurship pillar
S3_SDEC_P3=Finance Scale-up digital entrepreneurship pillar
S3_SDEC_P4= Networking and support Scale-up digital entrepreneurship pillar

7. **Normalisation of the pillars:** Similar to the previous cases we calculate the normalised scores for all the 16 pillars

$$p(norm)_{i,k} = \frac{p_{i,k}}{\max p_{i,k}} \quad (7)$$

for all k= 1 ... 16, the number of pillars
where $p(norm)_{i,k}$ is the normalised score value for country i and pillar k
$p_{i,k}$ is the original digital pillar value for country i and pillar k
$max\ p_{i,k}$ is the maximum value for pillar k

8. **Average pillar adjustment:** The different averages of the normalised values of the pillars imply that reaching the same indicator values requires different effort and resources. Since we want to apply the EIDES for public policy purposes, the additional resources for the same marginal improvement of the pillar values should be the same for all pillars. Therefore, we need a transformation to equalize the average values of the pillar components. Equation 8 shows the calculation of the average value of the k pillar:

$$\overline{p(norm)}_k = \frac{\sum_{i=1}^{n} p(norm)_{i,k}}{n} \quad \text{for all k} \quad (8a)$$

where $\overline{p(norm)}_k$ is the average value of all k=16 normalised pillars

We want to transform the $p(norm)_{i,k}$ values such that the potential values to be in the [0, 1] range.

$$y_{i,k} = p(norm)_{i,k}^{t} \quad (8b)$$

where t is the "strength of adjustment", the t-th moment of $p(norm)_k$ is exactly the needed average, $\bar{y}_j$

We have to find the root of the following equation for k:

$$\sum_{i=1}^{n} p(norm)_{i,k}^{t} - n\bar{y}_j = 0 \quad (8c)$$

It is easy to see based on previous conditions and derivatives that the function is decreasing and convex which means it can be quickly solved using the well-known Newton-Raphson method with an initial guess of 0. After obtaining k, the computations are straightforward.

9. ***Penalising:*** After these transformations, the Penalty for Bottleneck (PFB) methodology was used to create pillar-adjusted PFB values. We define our penalty function following as:

$$h_{(i),k} = min\ y_{(i),k} + (1 - e^{-(y_{(i)k} - min\ y_{(i),k})}) \qquad (9)$$

where $h_{i,k}$ is the modified, post-penalty value of pillar k in country i

$y_{i,j}$ is the normalised value of index component k in country i

y_{min} is the lowest value of $y_{i,k}$ for country i.

i = 1, 2,……28 = the number of countries

k= 1, 2,…….16= the number of pillars

10. ***Sub-index calculation:*** The value of a sub-index for any country was then calculated as the arithmetic average of its PFB-adjusted pillars for that sub-index multiplied by 100 to get a 100 point scale. Note that the general framework conditions pillars are the same for all stages

$$DE\_Stand\_up_i = \frac{100}{8}\left(\sum_{k=1}^{4} \mathrm{GDFC_P}_{i,k} + \sum_{k=5}^{8} \mathrm{S1\_SDEC\_P}_{i,k}\right) \qquad (10a)$$

$$DE\_Start\_up_i = \frac{100}{8}\left(\sum_{k=1}^{4} \mathrm{GDFC_P}_{i,k} + \sum_{k=5}^{8} \mathrm{S2\_SDEC\_P}_{i,k}\right) \qquad (10b)$$

$$DE\_Scale\_up_i = \frac{100}{8}\left(\sum_{k=1}^{4} \mathrm{GDFC_P}_{i,k} + \sum_{k=5}^{8} \mathrm{S3\_SDEC\_P}_{i,k}\right) \qquad (10c)$$

where

DE_Stand_up= Digital Entrepreneurship Stand-up sub-index

DE_Start_up= Digital Entrepreneurship Start-up sub-index

DE_Scale_up= Digital Entrepreneurship Scale-up sub-index

11. ***EIDES point calculation:*** Finally, the scores are calculated as simple arithmetic averages of the three sub-indices.

$$DEEI_i = \frac{1}{3}(DE\_Stand\_up_i + DE\_Start\_up_i + DE\_Scale\_up_i) \qquad (11)$$

Annex 2 Robustness Analyses of the EIDES and Its Components

In composite indicator analysis, the setting up of the final index is based upon a series of choices. The aim of the robustness (or uncertainty) analysis is to examine the extent to which the final ranking depends on the set of choices made during the selection and transformation of the variables (Van Roy-Nepelski 2016, Saisana et al. 2005).

The indicators which populate the pillars in the framework are generally chosen by integrating experts' judgment, data availability and checks on statistical consistency.

Robustness analysis in our case involves the followings:

— compensability effect analysis;

— the role of the pillars and the sub-indices in the development stages;

— drop out effect of the pillars.

1. Compensability effect analysis

In connection with the analysis of the effect of excluding one pillar at a time the next question is the amount of compensability effects. Compensability is the "existence of trade-off, i.e. the possibility of offsetting a disadvantage on some criteria by a sufficiently large advantage on another criterion" (Munda, 2008 71. p.). The EIDES will be the base for the comparison. More methods are applied. Ordered Weighted Averaging (OWA) approach is used for the pillars to present one aspect of compensability in case of EIDES. (Yager, 1996) This technique looks for different scenarios of weights to put together more variables into a single index. The variables are to be in descending order. From our point of view there are three special cases defined for the OWA operators (set of weights, where the sum of the weights is 1).

— Purely optimistic operator (o): the highest variable (in our case pillar) gets all of the weight (1). So the sub-index gets the highest pillar value. This concept expresses an "or" multiple criteria condition, where the satisfaction of at least one criterion is enough to have a good position.

— Purely pessimistic operator (p): the lowest pillar gets the weight 1. So the overall index will include only the value of the lowest pillar. It can be understood as an "and" condition. No compensation is allowed, all criteria must be satisfied at the same time.

— From our point of view an operator, which calculates a simple arithmetic mean of the pillars is interesting as well, to see, how far the penalty weighted results from the average situation are.

In each case, the final index value is calculated as a simple arithmetic mean from the sub-indices. So OWA operators are applied for the pillars.

Going further the best/worst/average possible outcomes two other well-known weighting schemes are also considered:

— Equal weights for the pillars (simple arithmetic mean) to get the sub-indices and geometric mean to receive the final index values (arithmetic+geometric).

— Geometric mean of the pillars to get the sub-indices and also geometric mean to receive the final index values (geometric+geometric).

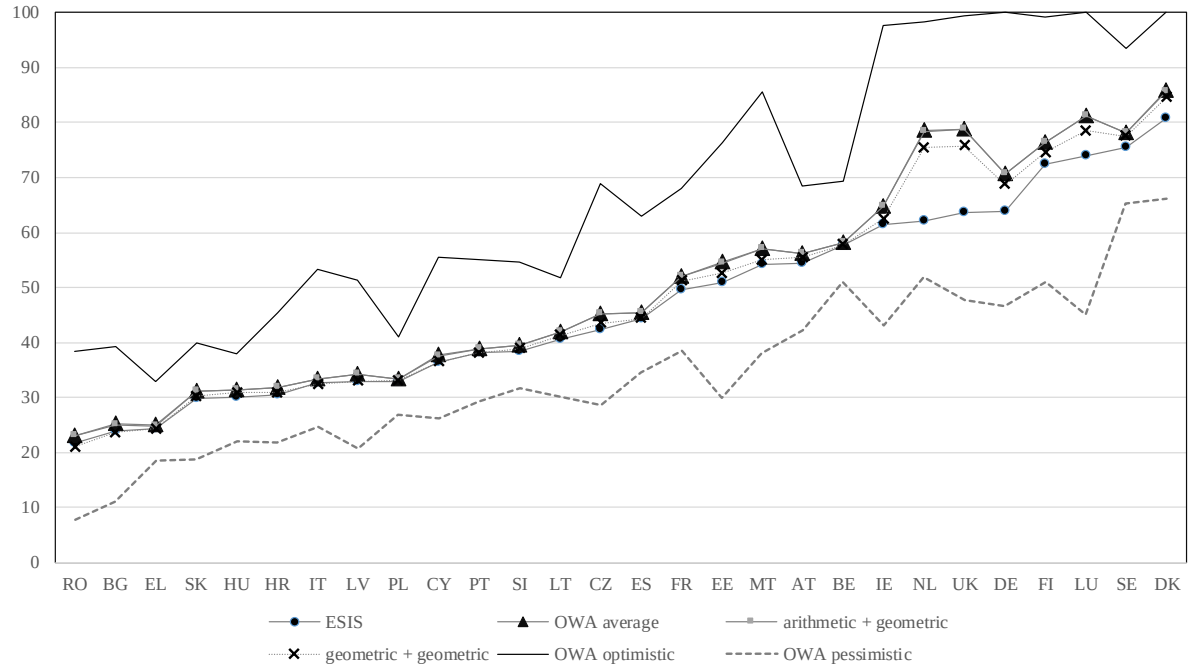
Geometric mean, similarly to out penalised weighting scheme, supports the "and" condition as it gives the lower results if the distribution of the pillar values is uneven.

Monte Carlo experiments are often applied in case of robustness checks, where random weights within a given range are simulated. In our case the penalised weighting accounts for different weights by countries according to the consistency of the pillar values. Therefore this type of simulation is not sufficient in our case. That is why we apply the above mentioned "extreme" (optimistic, pessimistic) scenarios together with different combination of the geometric mean, as its concept is closer to the idea behind the EIDES weighting.

Altogether we have five weighting scenarios, which will be compared to our (original) EIDES values. Besides comparing the final EIDES values, the ranks based on the different scenarios are also confronted. The results are presented in Figure A1 and A2.

As an obvious result, pessimistic and optimistic lines frame all the rest of the scenarios. It is also clear, that the aim of the penalty weighting was reached, as the EIDES are always below the average line. It means that compensability is restricted within the REDI indicator, and balanced performance is rewarded. Introducing the geometric mean in most of the cases results similar values with the EIDES and the simple arithmetic mean concepts. There are only two countries having higher differences between the penalised and the other three schemes. The Netherlands and the United Kingdom indicates the same patterns. Both have relatively high values in case of all pillars but one. This one is the "Networking and supporting" pillar within the start-up group with 0,17 and 0,21 respectively. The rest of the pillar values have a minimum over 0,60, so this one pillar in both countries causes the relevant difference of the final score. The penalised weights decrease the overall value of these countries.

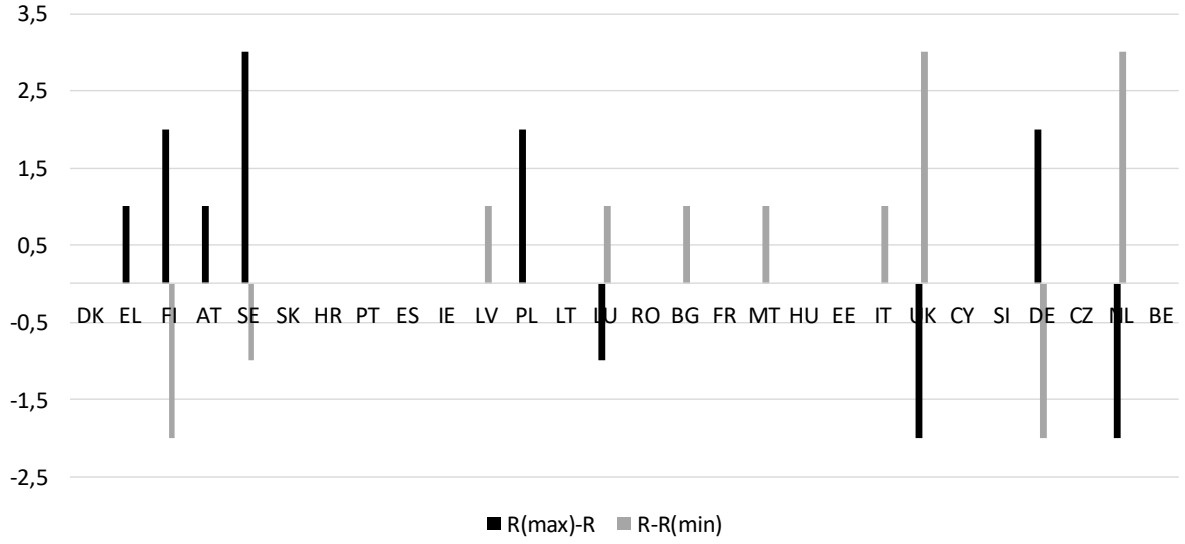
Figure A1. EIDES values calculated with different weighting scenarios



It is clear from Figure A1 that the penalised weighting scheme performs similarly as the non-extreme (extremes are the optimistic and pessimistic OWA solutions), but also reaches its objective of rewarding the balanced and unrewarding the unbalanced distribution of the pillar scores. Therefore in the followings, where the ranks are compared, we only focus on the non-extreme scenarios.

Figure A2 represents the differences of the maximum and minimum ranks by the non-extreme weighting scenarios compared to the original EIDES rank. In most of the cases (15 countries) the ranks are perfectly stable, so the original EIDES rank is exactly the same as the ranks based on other weighting scenarios. Even the highest differences in the ranks are only three positions. The effected countries are again The Netherlands and the United Kingdom, together with Sweden. The case of Sweden is similar to the other two, however the relative difference between the worst pillar (again "Networking and support") is not so high. The remaining 10 countries show one or two position differences. It can be concluded that the **weighting scheme of EIDES is free from distortion, while its penalising aim is sufficiently gained**.

Figure A2. Rank differences of non-extreme weighting scenarios compared to the original EIDES ranks (R)



2. Analysis by development stages

Based on the final sub-index and the EIDES values the following stages were determined:

— Laggards (EIDES below 35)

— Catchers-up (35 <EIDES≤ 45)

— Followers (45 <EIDES≤ 60)

— Leaders (EIDES over 60)

First the contribution of the final pillar values and the sub-indices to this grouping idea by development stages is to be checked. Analysis of variance (ANOVA)[18] is applied to see if the means are equal in the four groups, or, putting it another way, if the final pillars and the sub-indices show significant stochastic relationship with the development stages. Table A1 includes the results by pillars and Table A2 includes the results by sub-indices.

[18] The assumption of homogeneity of variances is not violated in any case, however, as the size of the groups is very limited, the results were double checked by Kruskal-Wallis nonparametric procedure and it had leaded to the same conclusions.

Table A1. ANOVA results for development stages and pillars

Structure		Pillar	F		Deviation ratio
Contextual influences		Culture and informal institutions	66.96	***	0.95
		Formal institutions and regulatory framework	90.27	***	0.96
		Market conditions	12.48	***	0.78
		Physical infrastructure	40.91	***	0.91
Entrepreneushiip sub-dynamics	Stand-up	Human capital	38.69	***	0.91
		Knowledge creation, transfer and absorption	43.02	***	0.92
		Finance	26.99	***	0.88
		Networking and support	13.07	***	0.79
	Start-up	Human capital	30.48	***	0.89
		Knowledge creation, transfer and absorption	31.07	***	0.89
		Finance	27.35	***	0.88
		Networking and support	2.81	*	0.51
	Scale-up	Human capital	56.56	***	0.94
		Knowledge creation, transfer and absorption	24.80	***	0.87
		Finance	34.98	***	0.90
		Networking and support	19.08	***	0.84

Table A2. ANOVA results for development stages and sub-indices

Sub-index	F		Deviation ratio
Stand-up	118.24	***	0.97
Start-up	145.14	***	0.97
Scale-up	97.66	***	0.96

In both tables (A1 and A2) the empirical F values, p-value indications (*p<0,100; **p<0,05 ***p<0,001) and the deviation ratio are included. The p-values are below 0,100 in each case, which means that the sub-indices as well as the pillars do have different mean values across the development stages. The deviation ratio suggests how strong is the relationship between the grouping criterion (development stage) and the quantitative variables (sub-indices and pillars). Relationships above 0,60 are considered as strong, between 0,30 and 0,60 as moderate and below 0,30 as weak. All the sub-indices and pillars indicate strong relationship with the development stages, which clearly justifies the results of the development stages.

Second, a pairwise comparison of the development stages was performed. As the group sizes are relatively small, the pairwise comparisons of the Kruskal-Wallis procedure were applied (instead of the post hoc tests of ANOVA) (Table A3 and A4).

Table A3 Kruskal-Wallis pairwise comparisons of development stages by pillars

Structure		Pillar	1-2	1-3	1-4	2-3	2-4	3-4
Contextual influences		Culture and informal institutions	0.181	**	***	**	***	0.209
		Formal institutions and regulatory framework	0.189	**	***	*	***	*
		Market conditions	0.866	0.103	**	*	***	0.134
		Physical infrastructure	0.141	**	***	0.151	***	*
Entrepreneuship sub-dynamics	Stand-up	Human capital	*	**	***	0.457	**	**
		Knowledge creation, transfer and absorption	0.357	**	***	*	***	0.121
		Finance	0.155	**	***	*	**	0.241
		Networking and support	0.320	**	**	**	**	0.564
	Start-up	Human capital	0.142	**	***	0.166	**	*
		Knowledge creation, transfer and absorption	0.323	**	***	*	***	0.159
		Finance	0.278	**	***	*	***	0.115
		Networking and support	0.172	**	**	0.513	0.127	0.330
	Scale-up	Human capital	0.160	**	***	0.104	***	0.104
		Knowledge creation, transfer and absorption	0.273	**	***	*	***	0.226
		Finance	0.229	**	***	**	***	0.293
		Networking and support	0.518	**	**	**	***	0.288

Table A4. Kruskal-Wallis pairwise comparisons of development stages by sub-indices

Sub-index	1-2	1-3	1-4	2-3	2-4	3-4
Stand-up	0.189	**	***	*	***	*
Start-up	0.188	**	***	*	***	*
Scale-up	0.188	**	***	*	***	*

Table A3 and A4 present the p-values of the Kruskal-Wallis pairwise comparisons. The significant differences indicate mainly the same pattern. The differences can be captured in the same way on the level of the pillars. Both tables suggest that differences are not significant at the lowest and highest levels (1-2 and 3-4). However, the in-between (1-3, 2-4) differences still indicate the necessity of the four digital entrepreneurship development levels.

The same comparison steps had been applied to the so called "raw" pillars. Those pillar values of the conceptual influences were utilized that had been formulated from the basic variables, before any transformation of these pillars. They might be considered as raw pillar values. The same idea of analysing the original entrepreneurship sub-dynamics pillars was applied by using the normalised and average adjusted pillar values, before the penalised weighting (as this was the first stage where the pillar values had been formulated). It is also important to discover the relationship of the "original" values, e.g. the values of the pillars before adjustments, transformations and normalisation or before the weighting. The same ANOVA procedure, as described above, is proceeded for the raw pillar values. Table A5 presents the results.

Table A5. ANOVA results for development stages and raw pillars

Structure		Raw Pillar	F		Deviation ratio
Contextual influences		Culture and informal institutions	21.03	***	0.85
		Formal institutions and regulatory framework	40.83	***	0.91
		Market conditions	12.06	***	0.78
		Physical infrastructure	16.17	***	0.82
Entrepreneushiip sub-dynamics	Stand-up	Human capital	25.45	***	0.87
		Knowledge creation, transfer and absorption	27.18	***	0.88
		Finance	15.97	***	0.82
		Networking and support	10.53	***	0.75
	Start-up	Human capital	20.20	***	0.85
		Knowledge creation, transfer and absorption	19.12	***	0.84
		Finance	15.27	***	0.81
		Networking and support	1.82	(p=0,171)	0.43
	Scale-up	Human capital	33.88	***	0.90
		Knowledge creation, transfer and absorption	17.56	***	0.83
		Finance	19.68	***	0.84
		Networking and support	12.13	***	0.78

The stochastic relationship between the development stages – set by the final EIDES values – and the raw pillars is significant and strong in every case, except for one, which is the "Networking and support". If we look back to the results of compensability effect analysis, we can realize that this is the same pillar, which had relatively low values in The Netherlands and in the United Kingdom. Most probably these nonconformist values cause the low empirical F value here. Altogether the strong relationship of the raw pillar values highly supports the adequacy of the transformation methods, as the final values kept the main characteristics of the original indicators.

Table A6. Kruskal-Wallis pairwise comparisons of development stages by raw pillars

Structure		Pillar	1-2	1-3	1-4	2-3	2-4	3-4
Contextual influences		Culture and informal institutions	0.263	**	***	**	***	0.384
		Formal institutions and regulatory framework	0.422	**	***	**	***	0.200
		Market conditions	0.848	**	***	0.132	**	0.148
		Physical infrastructure	*	**	***	0.209	**	0.343
Entrepreneushiip sub-dynamics	Stand-up	Human capital	0.116	**	***	0.457	**	**
		Knowledge creation, transfer and absorption	0.682	**	***	**	***	0.121
		Finance	0.283	**	***	*	***	0.270
		Networking and support	0.438	**	**	**	**	0.608
	Start-up	Human capital	0.187	**	***	0.151	**	*
		Knowledge creation, transfer and absorption	0.431	**	***	*	***	0.134
		Finance	0.402	**	***	*	***	0.127
		Networking and support						
	Scale-up	Human capital	0.208	**	***	*	***	0.134
		Knowledge creation, transfer and absorption	0.489	**	***	**	***	0.228
		Finance	0.357	**	***	**	***	0.363
		Networking and support	0.637	**	**	**	***	0.282

The pairwise comparisons results (Table A6) of the raw pillars are very similar to the results of the final pillars validating the transformation procedures.

It can be concluded that the comparisons by development stages represent similar results after and before transformations of the pillars and also for the sub-indices. **The level of the performance of the countries seems to be captured correctly by the weighted pillars and the sub-indices. These facts support the theoretical and methodological background of EIDES.**

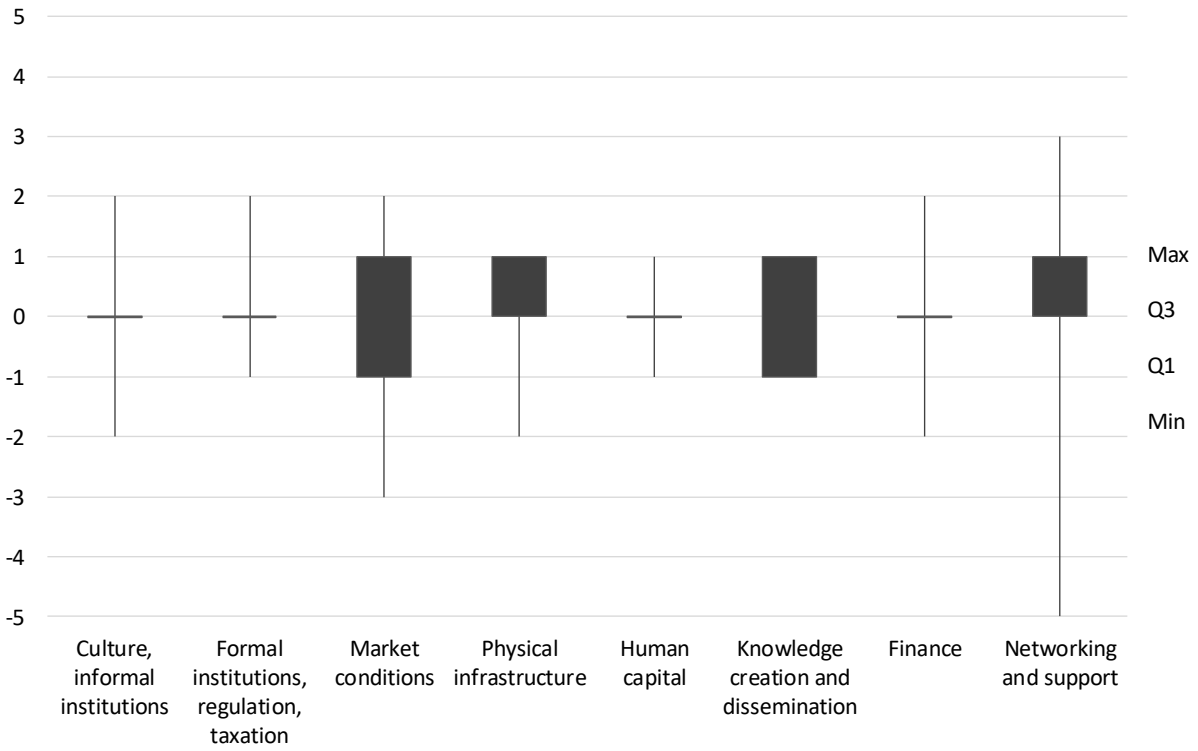
3. Drop out effect of the pillars

A typical test of the robustness of the result is to drop out one pillar at a time and view the changes in the rank of the regions (OECD 2008). It is an appropriate method to evaluate the balance among the pillars in EIDES. During this analysis EIDES values are calculated with the original methodology and the penalised weighting method, but we discarded one pillar at a time. So basically the weights just slightly changed (within a country the weight can be the lowest or the second lowest value during these simulations), however the effect of the missing pillar can be evaluated. The contextual influences pillars were dropped out individually. The entrepreneurship sub-dynamics pillars were removed from each phase (stand-up, start-up, scale-up) at the same time. Eight simulations were run to see the effect of excluding a pillar.

The box-plot figure (Figure A3) refers to the different simulations. It displays the minimum, maximum values together with the lower and upper quartile (Q_1, Q_3) values (range and interquartile range) of the distribution of the difference between the modified rank, obtained discarding one pillar, and the reference rank, computed on the basis of the original EIDES scores. The titles tells us, which pillar was excluded.

The interquartile range (Q3-Q1) is between zero and two, which means that in each case the middle 50% of the rank changes is at most only two positions. It proves that the main characteristics and the order of the countries are captured correctly by the EIDES methodology. There are no pillars prevailing over the rest of the aspects and the overall result is a balanced outcome of the pillars. Looking at the full range (max-min) the lowest is two positions, while the highest is eight. As it could have been expected, discarding "Networking and support" causes the highest diversity because of those three countries mentioned earlier.

Figure A3. Distribution of the rank differences, discarding one pillar at a time



Robustness analysis results in three different aspects supports the robustness of the REDI indicator. The results justify, that the index provides a synthetic picture of the European Digitalisation and Scale-up Index for the EU countries, while representing a balanced diversity of the different aspects (pillars).

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Annex 3. Structure and Description of EIDES Components

Table A7. General Framework Conditions (GFC)

GENERAL FRAMEWORK CONDITIONS (GFC)								
Indicators	**Code**	**Dataset**	**Type of data**	**Unit of measurement**	**Description**	**Sources**	**Date (2018 EIDES_NEW)**	**Date (2019 EIDES)**
CULTURE, INFORMAL INSTITUTIONS (GFC_P1)								
Efficiency of legal framework in setting disputes	GFC_P1_I1	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	Survey response: "In your country, how efficient are the legal and judicial systems for companies in settling disputes?" [1 = extremely inefficient; 7 = extremely efficient]	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018, weighted average 2017-2018
Corruption Perception Index	GFC_P1_I2	Transparency International	Aggregate	Score (0-100, 0 = highly corrupt, 100 = very clean)	See "Source description" file for detailed information about each country survey	https://www.transparency.org/news/feature/corruption_perceptions_index_2017 (12/01/2019)	2016 edition	2017 edition
Corporate governance	GFC_P1_I3	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Aggregate (subindex)	Score, 0-100 (best)	Aggregate of: (1) Survey response: “In your country, how strong are financial auditing and reporting standards?” [1 = extremely weak; 7 = extremely strong]; (2) Conflict of interest regulation index score; (3) Shareholder governance index score	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast	2018 edition
Attitudes towards entrepreneurial risk	GFC_P1_I4	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	“In your country, to what extent do people have an appetite for entrepreneurial risk?”	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018, weighted average 2017-2018
Reliance on professional management	GFC_P1_I5	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	”In your country, who holds senior management positions in companies?”	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018, weighted average 2017-2018
Willingness to delegate authority	GFC_P1_I6	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	”In your country, to what extent does senior management delegate authority to subordinates?”	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018, weighted average 2017-2018

FORMAL INSTITUTIONS, REGULATION, TAXATION (GFC_P2)								
Rule of law (Property rights)	GFC_P2_I1	Economic Freedom Index, Rule of Law pillar, Heritage Foundation	Aggregate	Score	Average of the following scores: Physical property rights; Intellectual property rights; Strength of investor protection; Risk of expropriation; Quality of land administration http://www.heritage.org/index/book/methodology#rule-of-law (12/01/2019)	https://www.heritage.org (12/01/2019)	2017 edition	2018 edition
Rule of law (Judicial Effectiveness)	GFC_P2_I2	Economic Freedom Index, Rule of Law pillar, Heritage Foundation	Aggregate	Score	Average of the following scores: Judicial independence; Quality of the judicial process; Likelihood of obtaining favourable judicial decisions http://www.heritage.org/index/book/methodology#rule-of-law (12/01/2019)	https://www.heritage.org/index/explore (12/01/2019)	2017 edition	2018 edition
Distortive effect of taxes and subsidies on competition	GFC_P2_I3	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	"In your country, to what extent do fiscal measures (subsidies, tax breaks, etc.) distort competition?"	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018, weighted average 2017-2018
Total tax rate	GFC_P2_I4	World Bank, Doing Business project	Indicator	% of commercial profits	Total tax rate (% of commercial profits) measures the amount of taxes and mandatory contributions payable by businesses after accounting for allowable deductions and exemptions as a share of commercial profits.	https://data.worldbank.org/indicator/ (12/01/2019)	2016	2017
Efficiency of legal framework in challenging regulations	GFC_P2_I5	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	Efficiency of legal framework in challenging regulations: "In your country, how easy is it for private businesses to challenge government actions and/or regulations through the legal system?" [1 = extremely difficult; 7 = extremely easy]	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018 edition (2018 or weighted average 2017-2018)
MARKET CONDITIONS (GFC_P3)								
Domestic market size	GFC_P3_I1	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Aggregate (pillar)	Score, 0-100 (best)	Combines Gross Domestic Product (GDP) valued at purchasing power parity with imports of goods and services, expressed as a percentage of GDP.	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, 2016 data	2018 edition, 2017 data
Urbanisation	GFC_P3_I2	United Nations, Department of Economic and Social Affairs, Population Division (2018). World Urbanization Prospects: The 2018 Revision, custom data acquired via website.	Indicator	%	Percentage of urban population: urban population refers to people living in urban areas as defined by national statistical offices. The data are collected and smoothed by United Nations Population Division.	https://population.un.org/wup/DataQuery/ (12/01/2019)	2017	2018

Opportunity startups (Exploiting a business opportunity)	GFC_P3_I3	Flash Eurobarometer Survey, 354 Entrepreneurship in the EU and beyond	Indicator	%	Why would you prefer to be self-employed rather than an employee? (Answer: Exploiting a business opportunity) (% of respondents)	http://ec.europa.eu/commfrontoffice/publicopinion/archives/flash_arch_360_345_en.htm#354 (28/11/2017)	2012	2012
Opportunity startups (Better income prospects)	GFC_P3_I4	Flash Eurobarometer Survey, 354 Entrepreneurship in the EU and beyond	Indicator	%	Why would you prefer to be self-employed rather than an employee? (Answer: Better income prospects) (% of respondents)	http://ec.europa.eu/commfrontoffice/publicopinion/archives/flash_arch_360_345_en.htm#354 (28/11/2017)	2012	2012
Extent of market dominance	GFC_P3_I5	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	"In your country, how do you characterise corporate activity?" [1 = dominated by a few business groups; 7 = spread among many firms]	WEF Global Competitiveness Report 2018 http://www3.weforum.org/ (12/01/2019)	2017 backcast, weighted average 2016-2017	2018 edition, 2018 or weighted average 2017-2018
Economic complexity	GFC_P3_I6	Observatory of Economic Complexity	Aggregate	Score	"The complexity of an economy is related to the multiplicity of useful knowledge embedded in it.... We ...measure economic complexity by the mix of ...products that countries are able to make." http://atlas.media.mit.edu/en/resources/economic_complexity/	http://atlas.media.mit.edu/en/rankings/country/eci/	2015-2016 average	2015-2016 average
Prevalence of non-tariff barriers	GFC_P3_I7	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	"In your country, to what extent do non-tariff barriers (e.g., health and product standards, technical and labelling requirements, etc.) limit the ability of imported goods to compete in the domestic market?" [1 = strongly limit; 7 = do not limit at all]	WEF Global Competitiveness Report 2018 http://www3.weforum.org/ (12/01/2019)	2017 backcast, weighted average 2016-2017	2018 edition, 2018 or weighted average 2017-2018
PHYSICAL INFRASTRUCTURE (GFC_P4)								
Electricity infrastructure	GFC_P4_I1	Word Economic Forum (WEF), Global Competitiveness Index 4.0 (International Energy Agency)	Aggregate (sub-pillar)	Score, 0-100 (best)	Aggregate of two indicators that measure the electrification rate and electric power transmission and distribution losses.	WEF Global Competitiveness Report 2018 http://www3.weforum.org/ (12/01/2019)	2017 backcast, 2014 estimate	2018 edition, 2016 estimate
Transportation infrastructure	GFC_P4_I2	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Aggregate (sub-pillar)	Score, 0-100 (best)	Aggregate of eight indicators that measure roads, railroads, air transport and water transport infrastructure.	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast (for different periods, but mostly: 2017 or weighted average 2016-2017)	2018 edition 2016 or weighted average 2017-2018 or most recent

Table A8. Systemic Framework Conditions (SFC)

SYSTEMIC FRAMEWORK CONDITIONS (SFC)								
STAND-UP (S1)								
Indicators	**Code**	**Dataset**	**Type of data**	**Unit of measurement**	**Description**	**Sources**	**Date (2018 EIDES_NEW)**	**Date (2019 EIDES)**
HUMAN CAPITAL (S1_SEC_P1)								
Quality of education	S1_SEC_P1_I1	IMD World Talent Ranking	Aggregate	score	Average of three indicators: "The educational system meets the needs of a competitive economy"; "University education meets the needs of a competitive economy"; "Management education meets the needs of the business community" (survey, Likert 0-10)	https://www.imd.org/wcc/world-competitiveness-center-rankings/talent-rankings-2017/ (23/01/2019)	2017	2018
Entrepreneurial attitude at schools	S1_SEC_P1 I2	Flash Eurobarometer Survey, 354 Entrepreneurship in the EU and beyond	Indicator	%	"My school education is helping/has helped me to develop my sense of initiative and a sort of entrepreneurial attitude" (survey, % of positive responses)	http://ec.europa.eu/commfrontoffice/publicopinion/archives/flash_arch_360_345_en.htm#354 (28/11/2017)	2012	
Future workforce	S3_SEC_P1_I3	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Aggregate (pillar)	Score 0-100 (best)	Aggregate of three indicators: (1) Total number of years of schooling (primary through tertiary) that a child of school entrance age can expect to receive (Source: UNESCO); (2) Response to the question “In your country, how do you assess the style of teaching?” [1 = frontal, teacher based, and focused on memorizing; 7 = encourages creative and critical individual thinking] (Source: WEF); (3) Average number of pupils per teacher, based on headcounts of both pupils and teachers. (Source: World Bank)	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast (very different years per country)	2018 edition (very different years per country)
KNOWLEDGE CREATION AND DISSEMINATION (S1_SEC_P2)								
Skillset of graduates	S1_SEC_P2_I1	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	Average score of the following questions: “In your country, to what extent do graduating students from secondary education possess the skills needed by businesses?” and “In your country, to what extent do graduating students from university possess the skills needed by businesses? ” In each case, the answer ranges from 1 (not at all) to 7 (to a great extent).|	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018 edition (2017–2018 weighted average or most recent period available)

Professionals & researchers	**S1_SEC_P2 I2**	Global Talent Competitiveness Index, 2018	Aggregate	Score (0-100)	Average value of two indicators: Professionals (%) | 2016; Full-time equivalent researchers (per million population) 2015	https://www.insead.edu/sites/default/files/assets/dept/globalindices/docs/GTCI-2018-report.pdf (23/01/2019)	2018 edition (data: 2016, 2015)	2019 edition (data: 2017, 2016)
Attracting and retaining talent	**S1_SEC_P2 I3**	IMD World Talent Ranking	Indicator	Likert scale (0-10)	Average score of the following statement: "[attracting and retaining talent] is a priority in companies"	https://www.imd.org/wcc/world-competitiveness-center-rankings/talent-rankings-2017/ (23/01/2019)	2017	2018
FINANCE (S1_SEC_P3)								
Domestic credit to private sector	**S1_SEC_P3_I1**	International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.	Indicator	% of GDP	Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable, that establish a claim for repayment. Domestic credit to private sector (% of GDP)	https://data.worldbank.org/indicator/ (12/01/2019)	2016	2017
Financing SMEs	**S1_SEC_P3_I2**	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	"In your country, to what extent can small- and medium-sized enterprises (SMEs) access finance they need for their business operations through the financial sector?" [1 = not at all; 7 = to a great extent]	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast (Weighted average 2016-2017)	2018 edition 2017–2018 weighted average or most recent period
NETWORKING AND SUPPORT (S1_SEC_P4)								
Opinion about entrepreneurs	**S1_SEC_P4 I1**	Flash Eurobarometer Survey, 354 Entrepreneurship in the EU and beyond	Indicator	%	What is your overall opinion about the following groups of people? Entrepreneurs (self-employed, business owners) (Broadly favourable, %) (survey)	http://ec.europa.eu/commfrontoffice/publicopinion/archives/flash_arch_360_345_en.htm#354 (28/11/2017)	2012	2012

START-UP (S2)								
Indicators	**Code**	**Dataset**	**Type of data**	**Unit of measurement**	**Description**	**Sources**	**Date (2018 EIDES_NEW)**	**Date (2019 EIDES)**
HUMAN CAPITAL (S2_SEC_P1)								
Tertiary education enrolment	S2_SEC_P1_I1	Eurostat	Indicator	%	Students in tertiary education - as % of the population	http://appsso.eurostat.ec.europa.eu/nui/show.do (23/01/2019)	2015	2016
Percentage of universities in top ranking	S2_SEC_P1_I2	Webometrics Ranking of World Universities, CSIC	Indicator	number of universities in TOP1000 / total number of universities	Number of universities in TOP1000 ranking divided by the total number of universities, by country	http://www.webometrics.info/en/node/54 (30/11/2017)	2017	2018
STEM education	S2_SEC_P1_I3	Eurostat	Indicator	number of graduates / 1000 of population aged 20-29	Graduates in tertiary education, in science, math, computing, engineering, manufacturing, construction, by sex - per 1000 of population aged 20-29	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=educ_uoe_grad04&lang=en (12/01/2019)	2015	2016
Human resources in science and technology	S2_SEC_P1_I4	Eurostat	Indicator	number of population in the age group25-64 / total active population aged 25-64, %	Human resources in science and technology (i.e. having successfully completed an education at the third level or being employed in science and technology) as a percentage of total active population aged 25-64	http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsc00025&plugin=1 (30/11/2017)	2016	2017
KNOWLEDGE CREATION AND DISSEMINATION (S2_SEC_P2)								
Quality of research institutions	S2_SEC_P2_I1	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	index	The prevalence and standing of private and public research institutions, calculated as the sum of the inverse ranks of all research institutions of a country included in the SCImago Institutions Rankings	WEF Global Competitiveness Report 2017–2018 http://www3.weforum.org/ (27/11/2017)	2017 backcast, 2016	2018 edition, 2017
Technicians and associate professionals	S2_SEC_P2_I2	International Labour Organisation (ILO)	Indicator	%	Employment distribution by occupation (by sex): Technicians and associate professionals	https://www.ilo.org	2016	2017
Science in schools	S2_SEC_P2_I3	IMD World Talent Ranking	Indicator	Likert scale (0-10)	"Science is sufficiently emphasised in schools" (score average)	https://www.insead.edu/sites/default/files/assets/dept/globalindices/docs/GTCI-2018-report.pdf (23/01/2019)	2017	2018
FINANCE (S2_SEC_P3)								

Venture capital availability	**S2_SEC_P3_I1**	World Economic Forum (WEF), Global Competitiveness Report 4.0	Indicator	Likert scale (1-7)	"In your country, how easy is it for start-up entrepreneurs with innovative but risky projects to obtain equity funding? [1 = extremely difficult; 7 = extremely easy]"	World Economic Forum, The Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2017–2018 weighted average or most recent period
Business angel investment	**S2_SEC_P3_I5**	EBAN Statistics Compendium European Early Stage Market Statistics	Indicator	investment million € per GDP per capita	Total business angel investment average of 2015-2016, €M per GDP per capita (PPP, current international $, 2016)	http://www.eban.org/wp-content/uploads/2018/07/EBAN-Statistics-Compendium-2017.pdf (12/01/2019)	2015-2016 average	2017
Early phrase VC	**S2_SEC_P3_I6**	Dow Jones	indicator	VC funding per million GDP	VC funding (calculated as 3-year moving averages) per GDP (Current prices, million euro)	https://www.dowjones.com/products/pevc/#tab-1 (02/12/2017)	2014-2016 average	
NETWORKING AND SUPPORT (S2_SEC_P4)								
EU Network places	**S2_SEC_P1_I1**	EU Enterprise Network homepage	Indicator	number of places per million population	Enterprise Europe Network number of places, per 1 000 000 population	http://een.ec.europa.eu/content/international-partnerships-0	27/11/2017	11/02/2019
EU Network members	**S2_SEC_P2_I2**	EU Enterprise Network homepage	Indicator	number of members per million population	Enterprise Europe Network members, per 1 000 000 population	http://een.ec.europa.eu/content/international-partnerships-0	27/11/2017	11/02/2019

SCALE-UP (S3)								
Indicators	**Code**	**Dataset**	**Type of data**	**Unit of measurement**	**Description**	**Sources**	**Date (2018 EIDES_NEW)**	**Date (2019 EIDES)**
HUMAN CAPITAL (S3_SEC_P1)								
Lifelong learning	**S3_SEC_P1_I1**	Eurostat	Indicator	%	Persons aged 25 to 64 who received education or training in the four weeks preceding the survey, % of respondents. Source: EU Labour Force Survey.	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=trng_lfse_01&lang=en (12/01/2019)	2016	2017
Extent of staff training	**S3_SEC_P1_I2**	World Economic Forum (WEF), Global Competitiveness Report 4.0	Indicator	Likert scale (1-7)	"In your country, to what extent do companies invest in training and employee development?" [1 = not at all; 7 = to a great extent]	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018 edition (2017–2018 weighted average or most recent period available)
Skilled labour	**S3_SEC_P1_I3**	IMD World Talent Ranking	Indicator	Likert scale (1-10)	"Skilled labour is readily available" (survey, Likert scale 0-10)	https://www.imd.org/wcc/world-competitiveness-center-rankings/talent-rankings-2017/ (23/01/2019)	2017	2018
Labour freedom	**S3_SEC_P1_I4**	Heritage Foundation	Aggregate	Score	Indicator of labour market regulation based on: (1) Ratio of minimum wage to the average value added per worker; (2) Hindrance to hiring additional workers; (3) Rigidity of hours; (4) Difficulty of firing redundant employees; (5) Legally mandated notice period; (6) Mandatory severance pay	http://www.heritage.org/index/labor-freedom (12/01/2019)	2017 edition	2018 edition
KNOWLEDGE CREATION AND DISSEMINATION (S3_SEC_P2)								
Gross domestic expenditure on R&D (GERD)	**S3_SEC_P2_I1**	Eurostat	Indicator	% of GDP	Gross domestic expenditure on R&D	http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_20&plugin=1 (12/01/2019))	average 2015-2016	2017
PCT patent applications	**S3_SEC_P2_I2**	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Number of patent / million population	Number of applications filed under the Patent Cooperation Treaty (PCT) per million population	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, 2011-2013 average	2018 edition (2012–2014 average)
Knowledge absorption	**S3_SEC_P2_I3**	GLOBAL INNOVATION INDEX	Aggregate	Score	Aggregate of: Intellectual property payments, % total trade; High-tech net imports, % total trade; ICT services imports, % total trade; FDI net inflows, % GDP; Research talent, % in	https://www.globalinnovationindex.org/analysis-indicator (12/01/ 2019)	2017 edition	2018 edition

					business enterprise			
University-industry collaboration in R&D	**S3_SEC_P2_I4**	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	"In your country, to what extent do business and universities collaborate on research and development (R&D)?" [1 = do not collaborate at all; 7 = collaborate extensively]	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018 edition (2017–2018 weighted average or most recent period available)
FINANCE (S3_SEC_P3)								
Later phase VC	**S3_SEC_P3_I1**	Dow Jones	Indicator	VC funding per million GDP	VC funding (calculated as 3-year moving averages) per GDP (Current prices, million euro)	http://blog.iese.edu/vcpeindex/heatmap/ (30/11/2017)	2014-2016 average	
Depth of capital market	**S3_SEC_P3_I2**	The Venture Capital & Private Equity Country Attractiveness Index Alexander Groh, Heinrich Liechtenstein, Karsten Lieser and Markus Biesinger	Aggregate	Score	http://blog.iese.edu/vcpeindex/about/	http://blog.iese.edu/vcpeindex/heatmap/ (30/11/2017)	2016	2018
Market capitalization	**S3_SEC_P3_I3**	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	% of GDP	Total value of listed companies as a percentage of GDP (end-of-year values)	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, different periods (between 2010-2018, sometimes moving average of a short period)	2018 edition (2014–2016 moving average)
Private Equity	**S3_SEC_P3_I4**	European Private Equity Activity, Invest Europe	Indicator	% of GDP	2016 European Private Equity Activity Market statistics: Location of the portfolio company	https://www.investeurope.eu (04/02/2019)	2015-2016 average	2017

NETWORKING AND SUPPORT (S3_SEC_P4)								
State of cluster development	**S3_SEC_P4_I1**	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Indicator	Likert scale (1-7)	"In your country, how widespread are well-developed and deep clusters (geographic concentrations of firms, suppliers, producers of related products and services, and specialised institutions in a particular field)?" [1 = non-existent; 7 = widespread in many fields]	WEF Global Competitiveness Report 2018 http://www3.weforum.org (12/01/2019)	2017 backcast, weighted average 2016-2017	2018 edition 2017–2018 weighted average or most recent period
Multi-stakeholder collaboration	**S3_SEC_P4_I2**	Word Economic Forum (WEF), Global Competitiveness Index 4.0	Aggregate	Likert scale (1-7)	Average score of the following questions: “In your country, to what extent do people collaborate and share ideas within a company?” [1 = not at all; 7 = to a great extent]; “In your country, to what extent do companies collaborate in sharing ideas and innovating?”; “In your country, to what extent do business and universities collaborate on research and development (R&D)?”	WEF Global Competitiveness Report 2017–2018 (27/11/2017)	2017 backcast, weighted average 2016-2017	2018 edition(2017–2018 weighted average or most recent period available)
Logistic index	**S3_SEC_P4_I3**	World bank	Aggregate	Likert scale (1-5)	Logistics performance index: Overall (1=low to 5=high)	https://lpi.worldbank.org/international/aggregated-ranking (13/01/2019)	2016	2018

Table A9. Digital Framework Conditions (DFC)

DIGITAL FRAMEWORK CONDITIONS (DFC)								
Indicator	**Code**	**Dataset**	**Type of data**	**Unit of measurement**	**Description**	**Sources**	**Date (2018 EIDES_NEW)**	**Date (2019 EIDES)**
CULTURE, INFORMAL INSTITUTIONS (DFC_P1)								
Households with personal computer	DFC_P1_I1	Eurostat	Indicator	% of household	% of households having access to, via one of its members, a computer	http://appsso.eurostat.ec.europa.eu/nui/show.do	2015	2017
Households with Internet access	DFC_P1_I2	Eurostat	Indicator	% of household	Percentage of households with Internet access at home	http://appsso.eurostat.ec.europa.eu/nui/show.do	2016	2018
Individuals using Internet	DFC_P1_I3	Eurostat	Indicator	% of individuals	Percentage of individuals using the Internet (in the last 3 months)	http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do	2016	2018
Enterprises having a website	DFC_P1_I4	Eurostat	Indicator	% of enterprises	Percentage of enterprises having a website (% of enterprises)	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_ciweb&lang=en (16/01/2019)	2017	2018
FORMAL INSTITUTIONS, REGULATION, TAXATION (DFC_P1)								
Government future orientation	DFC_P2_I1	World Economic Forum (WEF), Global Competitiveness Report 4.0	Aggregate	Likert scale (1-7)	Average of the following questions: 1) "In your country, how fast is the legal framework of your country in adapting to digital business models (e.g. e-commerce, sharing economy, fintech, etc.)?"; "In your country, to what extent does the government ensure a stable policy environment for doing business?"; "In your country, to what extent does the government respond effectively to change (e.g. technological changes, societal and demographic trends, security and economic challenges)?"; "In your country, to what extent does the government have a long-term vision in place?"	WEF Global Competitiveness Report 2018 http://www3.weforum.org (16/01/2019)	2017 backcast	2018 edition, 2017–2018 weighted average or most recent period available

Percentage of network attacks by Kaspersky	**DFC_P2_I2**	Securelist	Indicator	% of users	Percentage of users on whose devices Kaspersky Lab products intercepted network attacks in the last month	https://securelist.com/statistics/	2017	04/02/2019
Percentage of WEB treats	**DFC_P2_I3**	Securelist	Indicator	% of users	It shows the percentages of users on whose devices Kaspersky Lab products intercepted Web threats in the Last month. KL products' users are always protected from all – even the very latest – threats.	https://securelist.com/statistics/	2017	04/02/2019
Software piracy rate	**DFC_P2_I4**	World Bank, The Global Information Technology Report 2016	Indicator	% software installed	Unlicensed software units as a percentage of total software units installed	https://tcdata360.worldbank.org/indicators/entrp.piracy?country=BRA&indicator=3377&viz=line_chart&years=2012,2016 (17/01/2019)	2015	2016
Competition in network services	**DFC_P2_I5**	World Economic Forum (WEF), Global Competitiveness Report 4.0	Indicator	Likert scale (1-7)	"In your country, how competitive are the provision of the following services: c. Network sector (telecommunications, utilities, postal, transport, etc.)" [1 = Not at all competitive; 7 = Extremely competitive]	WEF Global Competitiveness Report 2018 http://www3.weforum.org (17/01/2019)	2017 backcast, weighted average 2016-2017	2018 edition, 2017–2018 weighted average or most recent period available
E-government	**DFC_P2_I6**	United Nations Department of Economic and Social Affairs Division for Public Administration and Development Management	Aggregate	Score	E-Government Development index is a composite measure of three dimensions of e-government: provision of online services, telecommunication connectivity and human capacity.	https://publicadministration.un.org/egovkb/Data-Center (17/01/2019)	2016	2018
MARKET CONDITIONS (DFC_P3)								
Individuals using the internet for ordering goods or services	**DFC_P3_I1**	Eurostat	Indicator	% of individuals aged 16 to 74	Buy or order for private use within the last 12 months. % of individuals aged 16 to 74	https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tin00096&plugin=1 (17/01/2019)	2017	2018
Enterprises having received orders via computer mediated networks, %	**DFC_P3_I2**	Eurostat	Indicator	% of enterprises	Enterprises having received orders online (at least 1%) - % of enterprises with at least 10 persons employed in the given NACE sectors	https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tin00111&plugin=1 (17/01/2019)	2017	2018

of enterprises								
Enterprises' total turnover from e-commerce	DFC_P3_I3	Eurostat	Indicator	% from total turnover	Enterprises' receipts from sales through electronic networks as percentage from total turnover. Enterprises with at least 10 persons employed in the given NACE sectors	https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tin00110&plugin=1 (17/01/2019)	2017	2018
Enterprises turnover from web sales	DFC_P3_I4	Eurostat	Indicator	% of turnover	Enterprises' turnover from web sales	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_ec_eval n2&lang=en (17/01/2017)	2017	2018
T-index	DFC_P3_I5	Translate.net	Indicator	Score	The T-Index is a percentage value that estimates the market share of each country in relation to global e-commerce. The higher the T-Index, the higher the online sales potential of a given country.	https://www.translated.net/en/languages-that-matter (02/12/2017)	2017	2017
Pay to advertise on the internet	DFC_P3_I6	Eurostat	Indicator	% of enterprises	Percentage of enterprises paying to advertise on the internet (% of enterprises)	http://appsso.eurostat.ec.europa.eu/nui/show.do (17/01/2019)	2016	2018
PHYSICAL INFRASTRUCTURE (DFC_P4)								
Prepaid mobile cellular tariffs	DFC_P4_I1	International Telecommunication Union (ITU)	Indicator	PPP $/Min	The price of a standard basket of mobile monthly usage for 30 outgoing calls per month (on-net/off-net to a fixed line and for peak and off-peak times) in predetermined ratios, plus 100 SMS messages . Calculated as a percentage of a country's average monthly GNI per capita PPP.	International Telecommunication Union (ITU),https://www.itu.int/pub/D-IND-WTID.OL-2017 (16/01/2019)	2016 (2017 edition)	2017 (2018 edition) online available data
Fixed broadband Internet tariffs	DFC_P4_I2	Word Economic Forum (WEF), Networked Readiness Index	Indicator	PPP $/Min	Monthly subscription charge for fixed (wired) broadband Internet service (PPP $)	International Telecommunication Union (ITU),https://www.itu.int/pub/D-IND-WTID.OL-2017 (16/01/2019)	2016 (2017 edition)	2017 (2018 edition) online available data
Average Download speed	DFC_P4_I3	TestMy.net	Indicator	Mbit/s	Average Download speed Mbit/s	http://testmy.net/country	2017 (07/12/2017)	2019.02.07
Average Upload speed	DFC_P4_I4	TestMy.net	Indicator	Mbit/s	Average Upload speed Mbit/s	http://testmy.net/country	2017 (07/12/2017)	2019.02.07
Speed	DFC_P4_I5	Digital Economy and Society Index (DESI)	Indicator	Score	DESI Speed sub-dimension calculated as the weighted average of the normalised indicators: 1c1 NGA Coverage (50%), 1c2 Subscriptions to Fast BB (50%)	https://digital-agenda-data.eu	2017	2018

Mobile network coverage	**DFC_P4_I6**	The Global Information Technology Report 2016, World Bank	Indicator	% of population	Mobile network coverage, % pop.	https://tcdata360.worldbank.org/indicators/entrp.mob.cov?country=BRA&indicator=3403&viz=line_chart&years=2012,2016 (17/01/2019)	2015	2016
Secure Internet servers	**DFC_P4_I7**	Netcraft (netcraft.com) and World Bank population estimates.	Indicator	servers per million population	The number of distinct, publicly-trusted TLS/SSL certificates found in the Netcraft Secure Server Survey. The number of secure Internet servers comes from the Netcraft Secure Server Survey. The survey examines the use of encrypted transactions through extensive automated exploration, tallying the number of web sites using HTTPS	https://data.worldbank.org/indicator/IT.NET.SECR.P6 (17/01/2019)	2016	2017

Table A10. Systemic Digital Conditions (SDC)

Indicators	Code	Dataset	Type of data	Unit of measurement	Description	Sources	Date (2018 EIDES_NEW)	Date (2019 EIDES)
SYSTEMIC DIGITAL CONDITIONS (SDC)								
STAND-UP (S1)								
HUMAN CAPITAL (S1_SDC_P1)								
Individuals with a daily access	S1_SDC_P1_I1	Eurostat	Indicator	% of individuals	Individuals - frequency of internet use: daily	http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do (17/01/2019)	2016	2018
Digital Skills Among Population	S1_SDC_P1_I2	Word Economic Forum (WEF), Networked Readiness Index 4.0	Indicator	Likert scale (1-7)	"In your country, to what extent does the active population possess sufficient digital skills (e.g., computer skills, basic coding, digital reading)?" [1 = not all; 7 = to a great extent]	WEF Global Competitiveness Report 2018 http://www3.weforum.org (17/01/2019)	2017 backcast, 2017	2018, 2017, 2017-2018 weighted average
Individuals above basic digital skills	S1_SDC_P1_I3	Eurostat	Indicator	% of individuals	Individuals who have above basic overall digital skills;% of individuals aged 16-74	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_sk_dskl_i&lang=en (02/12/2017)	2015	2017
KNOWLEDGE CREATION AND DISSEMINATION (S1_SDC_P2)								
Open access of scientific documents	S1_SDC_P1_I1	OECD Science, Technology and Industry Scoreboard 2017	Indicator	%	Open access of scientific documents, 2017, % of a random sample of 100 000 documents	OECD Science, Technology and Industry Scoreboard 2017	2017	2017
Wikipedia yearly edits	S1_SDC_P1_I2	Global Innovation Index 2017	Indicator	per million population 15-69 years old	Wikipedia yearly page edits (per million population 15–69 years old)	https://www.globalinnovationindex.org/gii-2017-report	2016 (2017 edition)	2017 (2018 edition)
YouTube video uploads	S1_SDC_P1_I3	Global Innovation Index 2017	Indicator	scaled by population 15–69 years old	Number of video uploads on YouTube (scaled by population 15–69 years old)	https://www.globalinnovationindex.org/gii-2017-report	2016 (2017 edition)	2017 (2018 edition)
FINANCE (S1_SDC_P3)								
Digital payment transactions	S1_SDC_P1	Statista	Indicator	transactions by million USD 2017 / GDP (current $, 2015-2016 average)	Digital payment transactions by million USD 2017 / GDP (current $, 2015-2016 average)	https://www.statista.com/statistics/276233/eu-member-states-with-the-most-cashless-payment-transactions/ (24/11/2017)	2017	2019

Number of cashless payment transactions	S1_SDC_P2	Statista	Indicator	transactions, million / GDP (current $, 2015-2016 average)	Number of cashless payment transactions, million / GDP (current $, 2015-2016 average)	https://www.statista.com/statistics/276233/eu-member-states-with-the-most-cashless-payment-transactions/ (24/11/2017)	2017	2017
Internet banking	S1_SDC_P3	Eurostat	Indicator	% of individuals	Percentage of individuals using internet banking (average of 2016-2017 data), internet banking includes electronic transactions with a bank for payment etc. or for looking up account information	http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&language=en&pcode=tin00099	average 2016-2017	2018
NETWORKING AND SUPPORT (S1_SDC_P4)								
Generic top-level domains (gTLDs)	S1_SDC_P4_I1	Global Innovation Index 2017	Indicator	(per thousand population 15–69 years old	Generic top-level domains (gTLDs) (per thousand population 15–69 years old)	http://www3.weforum.org/docs/GITR2016/WEF_GITR_Full_Report.pdf (02/12/2017)	2016 (2017 edition)	2017 (2018 edition)
Participating in social networks	S1_SDC_P4_I2	Eurostat	Indicator	% of individuals aged 16 to 74	Internet use: participating in social networks (creating user profile, posting messages or other contributions to Facebook, twitter, etc.). % of individuals	https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tin00127&plugin=1	2016	2018
Use of virtual professional networks	S1_SDC_P4_I3	Global Talent Competitiveness Index, 2019	Score	LinkedIn users (per 1,000 labour force) | 2015	LinkedIn users (per 1,000 labour force)	https://www.insead.edu/sites/default/files/assets/dept/globalindices/docs/GTCI-2018-report.pdf (23/01/2019)	2015 (2018 report)	2016 (2019 report)

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START-UP (S2)								
Indicators	**Code**	**Dataset**	**Type of data**	**Unit of measurement**	**Description**	**Sources**	**Date (2018 EIDES_NEW)**	**Date (2019 EIDES)**
HUMAN CAPITAL (S2_SDC_P1)								
Employed ICT specialists	S2_SDC_P1_I1	Eurostat	Indicator	Employed ICT specialists per population	Employed ICT specialists per population	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_sks_itspt&lang=en (17/01/2019)	2016	2017

KNOWLEDGE CREATION AND DISSEMINATION (S2_SDC_P2)								
Employment in high tech and KIBs	S2_SDC_P2_I1	Eurostat	Indicator	% of total employment	Employment in high- and medium-high technology manufacturing sectors and knowledge-intensive service sectors as a percentage of total workforce	http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tsc00011&plugin=1	2016	2017
Software developers	S2_SDC_P2_I2	Developer survey	Indicator	% of professional developers	Number of software developers per 1000 capita	https://insights.stackoverflow.com/survey/2018	2017	2018
FINANCE (S2_SDC_P3)								
Alternative finance 1	S2_SDC_P3_I1	Cambridge Centre for Alternative Finance	Indicator	Euro per capita	Alternative market volume per capita	https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/centres/alternative-finance/downloads/2016-european-alternative-finance-report-sustaining-momentum.pdf	2016	2016
Alternative finance 2	S2_SDC_P3_I2	THE 3rd EUROPEAN ALTERNATIVE FINANCE INDUSTRY REPORT	Indicator	per million capita	Total alternative finance volume per million capita	https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/centres/alternative-finance/downloads/2018-ccaf-exp-horizons.pdf	2016	2016
Alternative finance 3	S2_SDC_P3_I3	THE 3rd EUROPEAN ALTERNATIVE FINANCE INDUSTRY REPORT	Indicator	per million capita	European business volumes per million capita	https://www.jbs.cam.ac.uk/fileadmin/user_upload/research/centres/alternative-finance/downloads/2018-ccaf-exp-horizons.pdf	2016	2016
Alternative finance 4	S2_SDC_P3_I4	Statista	Indicator	US$ per capita	Alternative finance transaction volume	https://www.statista.com/outlook/297/102/alternative-financing/europe#market-globalRevenue	2019	2019
NETWORKING AND SUPPORT (S2_SDC_P4)								
Accelerator number	S2_SDC_P4_I1	European Accelerator Report, gust	Indicator	per GDP per capita	EU MSs Accelerator Counts (EUR) / GDP per Capita (current prices, euro per capita)	http://gust.com/accelerator_reports/2016/europe/	2016	2016
Accelerator Amounts	S2_SDC_P4_I2	European Accelerator Report, gust	Indicator	per GDP per capita	EU MSs Accelerator Amounts (EUR) / GDP per Capita (current prices, euro per capita)	http://gust.com/accelerator_reports/2016/europe/	2016	2016
Meetup Events /Meetup Tech Group Indicator (MTGI)	S2_SDC_P4_I3	meetup.com	Indicator	per capita		https://www.meetup.com/ (own calculation)	22/01/2018	2018 – 2019

Meetup Members /Meetup Tech Member indicator (MTMI)	S2_SDC_P4_I4	meetup.com	Indicator	per capita		https://www.meetup.com/ (own calculation)	22/01/2018	2018 - 2019
Meetup Tech Event Activity (MTEA)	S2_SDC_P4_I5	meetup.com	Indicator	per capita		https://www.meetup.com/ (own calculation)		2018 – 2019
Meetup Tech Member Activity (MTMA)	S2_SDC_P4_I6	meetup.com	Indicator	capita or tech group		https://www.meetup.com/ (own calculation)		2018 - 2019

SCALE-UP (S3)								
Indicators	**Code**	**Dataset**	**Type of data**	**Unit of measurement**	**Description**	**Sources**	**Date (2018 EIDES_NEW)**	**Date (2019 EIDES)**
HUMAN CAPITAL (S3_SDC_P1)								
Internet use: finding information for goods and services	S3_SDC_P1_I1	Eurostat	Indicator	% of individual	Internet use: looking for information for goods and services,% of individuals	http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database (17/01/2019)	2017	2018
Internet use: doing an online course	S3_SDC_P1_I2	Eurostat	Indicator	% of individual	Internet use: doing an online course (of any subject),% of individuals	http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database (17/01/2019)	2016	2017
KNOWLEDGE CREATION AND DISSEMINATION (S3_SDC_P2)								
Enterprises who have ERP software	S3_SDC_P2_I1	Eurostat	Indicator	% of enterprises	Enterprises who have ERP software package to share information between different functional areas, % of enterprises	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=isoc_eb_iip&lang=en (17/01/2019)	2015	2017

Website has online ordering, reservation or booking	**S3_SDC_P2_I2**	Eurostat	Indicator	% of enterprises	Website has online ordering, reservation or booking and at least one of: webacc, webctm, webot or webper	http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database (03/12/2017)	2016	2018
FINANCE (S3_SDC_P3)								
Fintech	**S3_SDC_P3_I1**	dealroom.co	Indicator	businesses per million capital	Number of financial technology businesses per 1 000 000 capita	https://app.dealroom.co/companies/f/industries/fintech/locations/Europe (20/10/2017)	2017	2018.03.27
NETWORKING AND SUPPORT (S3_SDC_P4)								
Enterprises whose business processes are automatically linked to those of their suppliers and/or customers	**S3_SDC_P4_I1**	Eurostat	Indicator	% of enterprises with at least 10 persons employed in the given NACE sectors. NACE Rev 2 since 2009 (break in series in 2009)	Sharing information electronically in the supply chain: (1) all types of information with suppliers and/or customers to coordinate the availability and delivery of products or services; (2) information on demand forecasts, inventories, production, distribution or product development	https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tin00115&plugin=1 (17/01/2019)	2014-2015 average	2017
Enterprises using software solutions, like CRM to analyse information about clients for marketing purposes	**S3_SDC_P4_I2**	Eurostat	Indicator	% of enterprises with at least 10 persons employed in the given NACE sectors. NACE Rev 2 since 2009 (break in series in 2009)	Enterprises using software solutions, like CRM to analyse information about clients for marketing purposes - % of enterprises with at least 10 persons employed in the given NACE sectors. NACE Rev 2 since 2009 (break in series in 2009)	https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=tin00116&plugin=1 (17/01/2019)	2014-2015 average	2017
Total investment in networks by electronic communications sector	**S3_SDC_P4_I3**	Digital Agenda key indicators	Indicator	Total (in % of revenue of the Electronic Communication Sector)	Investments of telecommunications sector in networks eur/capita	http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do	average 2010-2012	average 2014-2015

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